User Manual

R2485 Rectifier and DC Rack Power System

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1. General Warnings

1. This equipment has been designed to be used only in restricted access areas.
2. This equipment must only be serviced by authorized and qualified service personnel.
3. Operators should not attempt to repair faulty units. There are no operator serviceable parts inside. All fuses are only replaced **as part of a repair procedure in a repair facility by authorized personnel** and not as a maintenance procedure on site.
4. The rectifier must be mounted in an IEC 19-inch rack which satisfies requirements for electrical enclosures and fire enclosures according to IEC 950 or equivalent standard.
5. The top and bottom of the rectifier must not be accessible during operation. The front of the rack must be closed off to prevent operator access to the top and bottom of the rectifier. Any openings in the front of the rack above or below the rectifiers must be closed off by equipment, blanking panels or ventilation panels.
6. The rectifiers must be used with sufficient ventilation. After mounting, the air flow paths into and out of the rectifier must be unrestricted. Allow adequate flow for hot exit air at the top.
7. Prevent small items from falling into the top of the rectifier. See the section on Rack Installation for suggestions of appropriate measures and examples of options.
8. In Equalize Mode, the SMRs are capable of outputting voltages in excess of the SELV limit of 60V. Accordingly, appropriate precautions must be observed in Equalize Mode if the voltage exceeds 60V.
9. The input disconnect device is the rectifier back plane connector. The rectifier is live at all times when the rectifier back plane connector is connected.
10. Take care when removing the rectifier as it may be too hot to touch the metal casing, especially if the ambient temperature is high and the unit has been operating at maximum load. When removing, pull the unit halfway out of the magazine and let cool for 2-3 minutes before handling.

2. Configuration

2.1. System Description

This Manual has been written with the objective of giving the reader a sufficient understanding of the system and its constituent parts in order to be able to install, commission and operate the system.

2.2. General Description

This modular system has been designed specifically to power 48V telecommunications equipment requiring accurate temperature compensated Float and Equalisation voltages, low output noise and EMI levels.

A typical system comprises a number of rectifiers, depending on the power requirement of the system, and a monitoring and control subsystem comprising a monitoring and control module (MCSU), a User Interface Board (MUIB) and optional modules for monitoring 1 phase AC power. The example rack power system outline is shown in **Figure 2.1**.

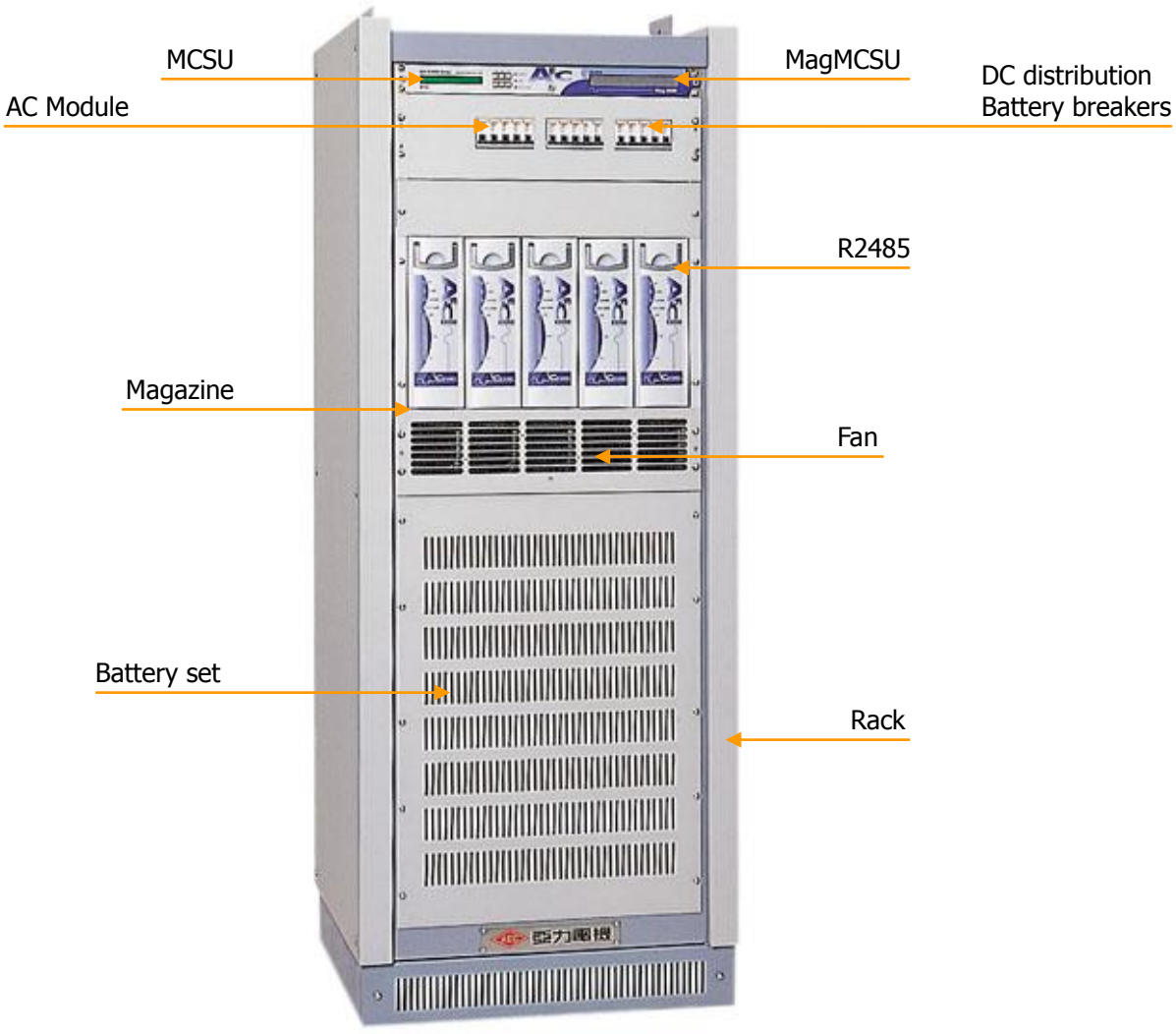


Figure 2.1 Rack Power system outline

The system can be configured in a number of ways depending on the customer and application requirements. The simplest option is shown in **Figure 2.2**.

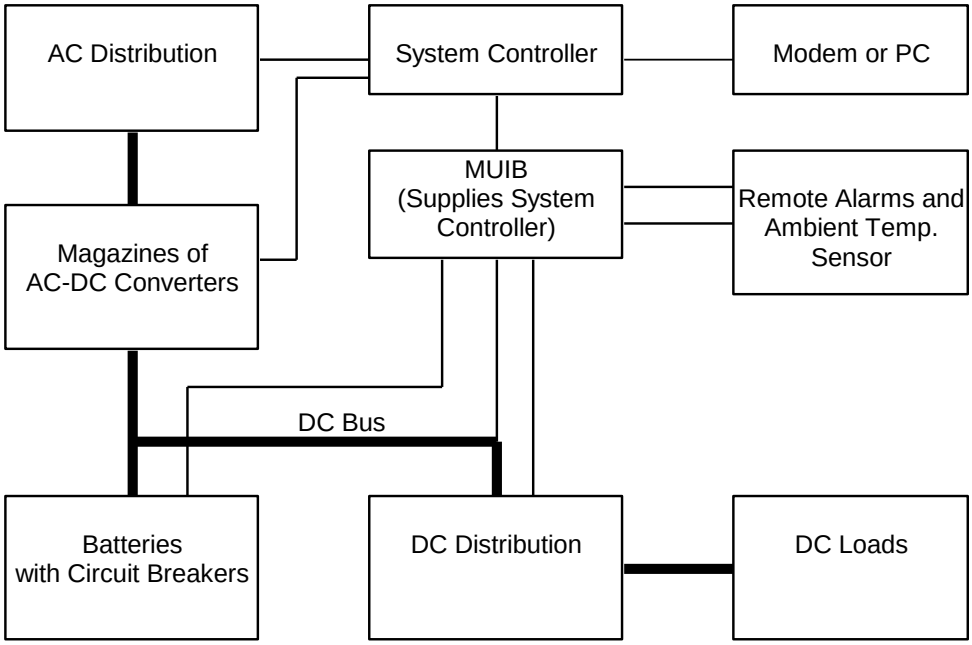


Figure 2.2 System with basic monitoring and control

The AC Distribution may simply consist of circuit breakers, one for each magazine of rectifiers in the system, or may also include an isolator, depending on customer requirements.

The rectifiers housed in one or more magazines are paralleled and the DC output connected to the load via the DC Distribution module and to the battery bank, which may be a single battery or two batteries connected in parallel. A Low Voltage Disconnect Switch (LVDS) may also be included in series with the batteries in order to prevent over-discharging the battery bank in the event of an unusually long AC power outage.

The monitoring and control signals, such as battery currents, temperature, battery switch status, LVDS control and status, system voltage and ambient temperature are connected to the monitoring and control module (MCSU) via an interface card (MUIB). This module is in turn connected to the MCSU via a 34-way ribbon cable.

A 4-wire cable, which carries the digital communications signals that allow control and monitoring of the rectifiers, connects the MCSU to all the rectifiers in a parallel arrangement so that all the rectifiers receive the same signal.

Remote monitoring of the system can be by means of 3 voltage-free relay contacts corresponding to SMR shutdown, SMR Alarm and High Voltage Shut Down (HVSD).

Alternatively, an RS-232 port can be used to display all the system and rectifier information at a local PC or, by connection to a Modem and PSN, at a remote PC.

With this facility, it is possible to not only monitor but also control all the rectifier and system parameters. In addition, the system has the capability to dial up to three telephone numbers to connect to the remote PC in the event of a system fault having developed, and will continue dialing until the fault is reported.

With the remote communications option there is also provision for controlling the state of an output relay. This relay could be used to control external equipment, for example a standby generator or an air conditioner. This facility is particularly useful when the plant is in a remote, unmanned location.

The second option shown in **Figure 2.3** is the basic arrangement described above with the addition of an auxiliary single phase AC monitoring module and Battery Cell Monitor. This module, which is mounted in the AC distribution module, connects via a ribbon cable to the MUIB and is used to monitor the AC voltage, current and frequency.

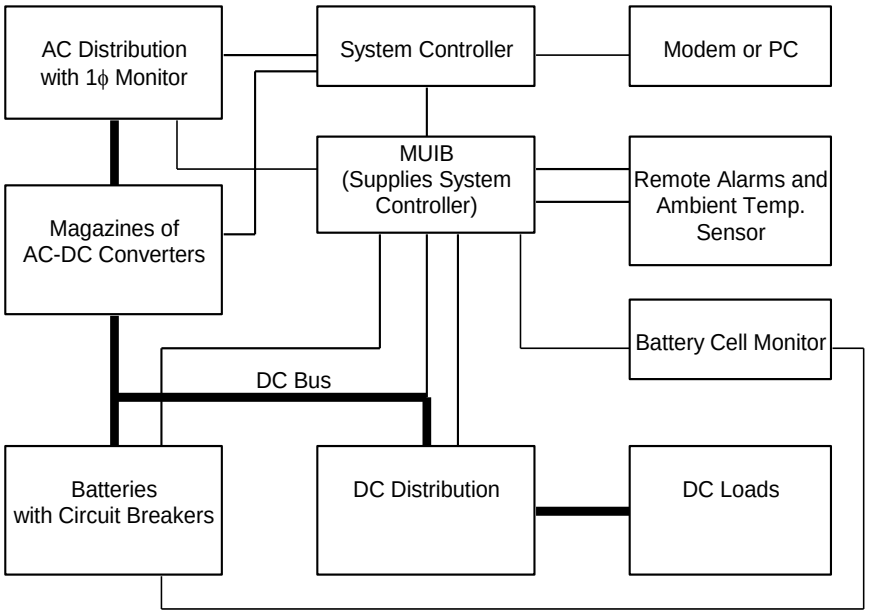


Figure 2.3 System with additional single phase AC Monitor

The third option shown in **Figure 2.4** is the basic arrangement with the addition of an auxiliary three-phase AC monitoring module. The latter connects directly to the MCSU via a ribbon cable and provides monitoring of the three AC voltages and currents as well as the AC frequency. It has multiplexing circuits on board, which effectively extends the analogue monitoring ability of the MCSU.

It is possible to have both the single and three phases AC monitoring modules connected at the same time. This can be useful where the AC output of an inverter running off the 48V DC bus can be monitored at the same time as the three phase AC supply to the rectifiers.

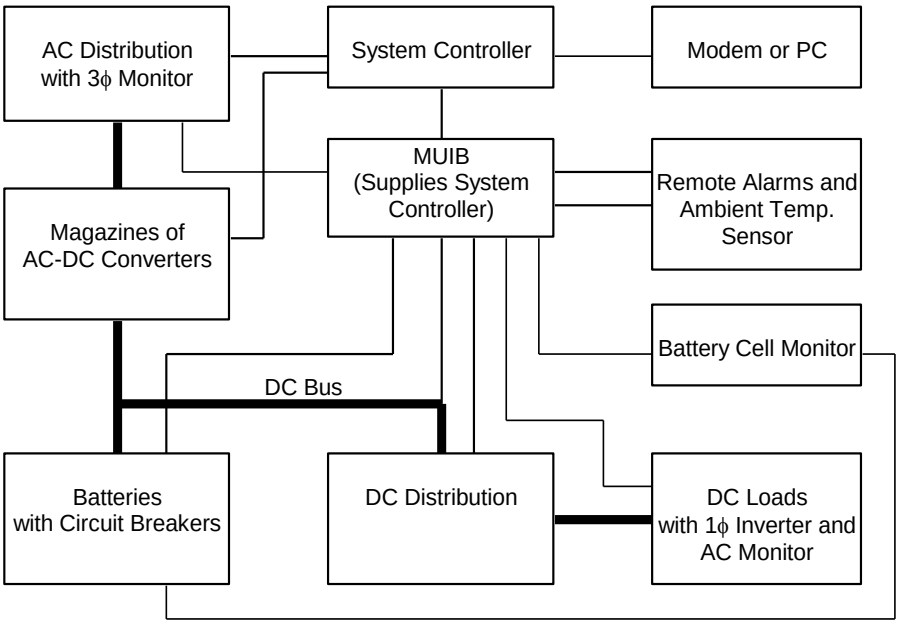


Figure 2.4 System with additional 3 phase AC Monitoring; simultaneous monitoring of single phase inverter also possible

2.3. Rectifier Specific Configurations

A typical mechanical arrangement of a system comprising 5-rectifier is shown in **Figure 2.5**. Consists of a rectifier magazine (6U) with provision for air intake (3U) and exhaust (3U) for the rectifiers, which are cooled by natural convection. A 1U high shelf accommodates the MCSU, MUIB and modem if the latter is used.

The arrangement shown is designed to fit into a standard 19" rack or can be fitted with side flanges for wall mounting.

The width of the MCSU is the same as that of two rectifiers so that a very compact 3-rectifier arrangement can be configured as shown in **Figure 2.6**. A combined AC and DC distribution module completes the system.

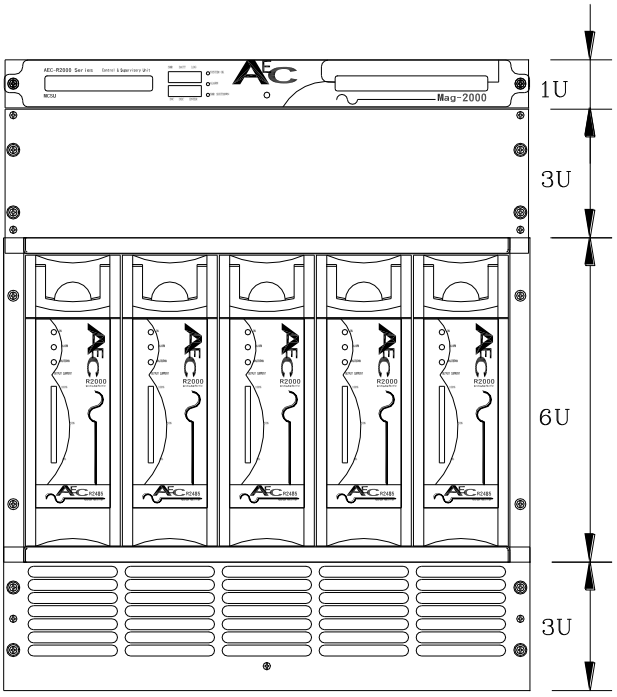


Figure 2.5 Typical 5-rectifier modular power supply

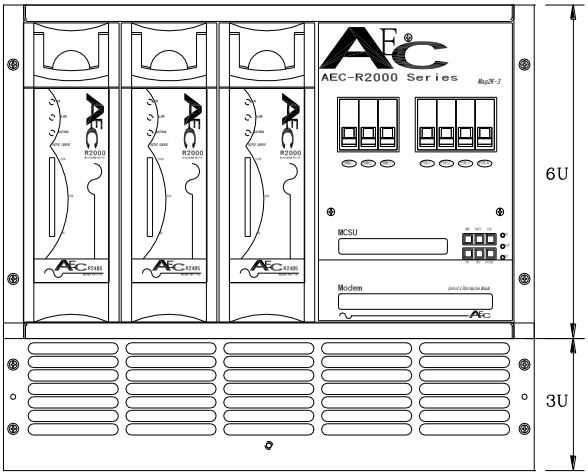


Figure 2.6 Typical 3-rectifier modular power system

3. System Installation

The installation of an uninterruptible DC power system incorporating rectifiers, batteries and control hardware requires compliance to National Wiring Standards, and appropriate sections of standard IEC950 to ensure safety of operators and supplementary equipment. Wiring should always be done by qualified personnel.

3.1. Racks

The structure and continuity of the rack provide both system safety compliance and additional shielding for electromagnetic compatibility (EMC) of the DC power system. The rack enclosure needs to have the following features to provide safe and efficient system operation:

- The rack must form a basic fire enclosure. To do this, a rack needs a separator or base plate, which prevents a burning liquid from escaping the enclosure when poured vertically into the rack. This can be achieved by using either a baffle plate below the rectifiers with a front finger grill that traps the liquid or a purpose made separation plate that it mounted below the rectifier magazine to catch burning liquids.
- Openings in the top and sides of the enclosure must comply with the following:
    - not exceed 5mm in any direction, or
    - not exceed 1mm in width regardless of length, or
    - for the top of the enclosure, be constructed that direct, vertical entry of falling objects be prevented from reaching bare parts at HAZARDOUS voltage (>32VAC or >60VDC), and/or,
    - for the sides of the enclosure, be provided with louvres that are shaped to deflect outwards an externally falling object.
- Sufficient ventilation must be provided for rectifier cooling. The examples given previously of system configurations provide adequate inlet cooling, but the construction of the rack is important in providing exhaust air venting. Cooling louvres, vent holes or a rack with a 'top hat' construction are all good methods of obtaining good ventilation while maintaining compliance with item ii) above.

The rack needs to be able to mount 19" rack equipment, have a depth not less than 400mm and a minimum height for enclosing the magazine and cooling vents of 12U for both rectifier systems.

3.2. Magazines

The two types of magazine configurations shown in **Figure 3.1** (3-way and 5-way) metalwork and wiring are usually manufactured as a module with terminal blocks to accept AC wiring and DC output cables. These magazines should be located in the rack to allow adequate cooling of rectifiers, noting that the airflow is from the bottom front to the top rear of the magazine. A baffle plate or 'scoop' is used to stack multiple magazines to provide inlet/exhaust air separation for each magazine.

The magazines are held in the rack by four M6 screws through the mounting flange and into the rack mounting rail. In the case of the 3-rectifier magazine, the MCSU is an integral part and access to all wiring is typically via rear access. Alternatively, the 5 rectifier magazine requires the MCSU to be mounted in a 1U tray either at the top or bottom of the rack, thereby requiring some degree of top or rear access to wiring.

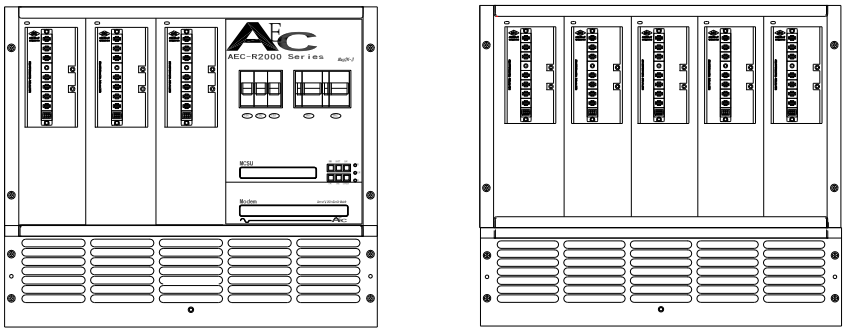


Figure 3.1 3-Way & 5-Way Magazines

Considerations for the location of the user interface card (MUIB) which connects to the MCSU by a ribbon cable, should be based on the type of access (rear, top, front) and will similarly impact on the general location of control and system wiring. If rear access is available, the MUIB can be mounted on the rear of the 3-rectifier magazine. The larger systems usually have the MUIB mounted on the side panel of the rack near the top to allow access through the top once the cooling grill is removed. The end result must be that the user terminals of the MUIB are readily accessible.

3.3. Lightning and Transient Suppression

The rectifiers and magazine contain basic transient suppression in the form of Metal Oxide Varistors (MOVs) across line-to-neutral, line-to-earth and neutral-to-earth. These MOVs are sized to provide protection from typical line transients in an industrial environment according to ANSI C62.41-1991 (6kV/3kA) and IEC 61000-4-5 (Level X). Under these conditions, the MOVs are expected to provide transient protection for the life of the rectifiers.

If the transient environment is more severe, with a high incidence of lightning strikes either indirect or direct, and/or severe switching transients beyond the levels outlined in the standard, then supplementary transient protection is required. Larger MOVs (40kA rating) are required at the AC main switch board where the power to the rack originates.

For wiring systems where the neutral is bonded to the building earth at the main switchboard (as used for example in Australia, USA, and Canada), one MOV from line-to-neutral is required for single phase, and three MOVs from each line-to-neutral are required for three phases.

For wiring systems where the protective earth is bonded to the neutral conductor only at the distribution transformer, as is common in Europe, three MOVs are required for a single phase (line-to-neutral, line-to-earth, neutral-to-earth), and seven MOVs are required for three phase wiring (phase-to-neutral x 3, phase-to-earth x 3 and neutral-to-earth).

3.4. Cabling, Auxiliary Equipment and Circuit Breakers

In general, the system needs to have the following modules: AC Module, DC Distribution Module, Battery Circuit Breakers, Low Voltage Disconnect Switch (LVDS), DC Cabling, Battery Current Transducers, Temperature Sensors and AC Monitoring Module (optional).

These modules are required inside the rectifier rack for normal system operation. In smaller systems such as the 3-rectifier configuration, many of these modules are already included in the magazine. A brief description of the modules and what they connect to is given below, along with a detailed rack wiring diagram in **Figure 3.2**:

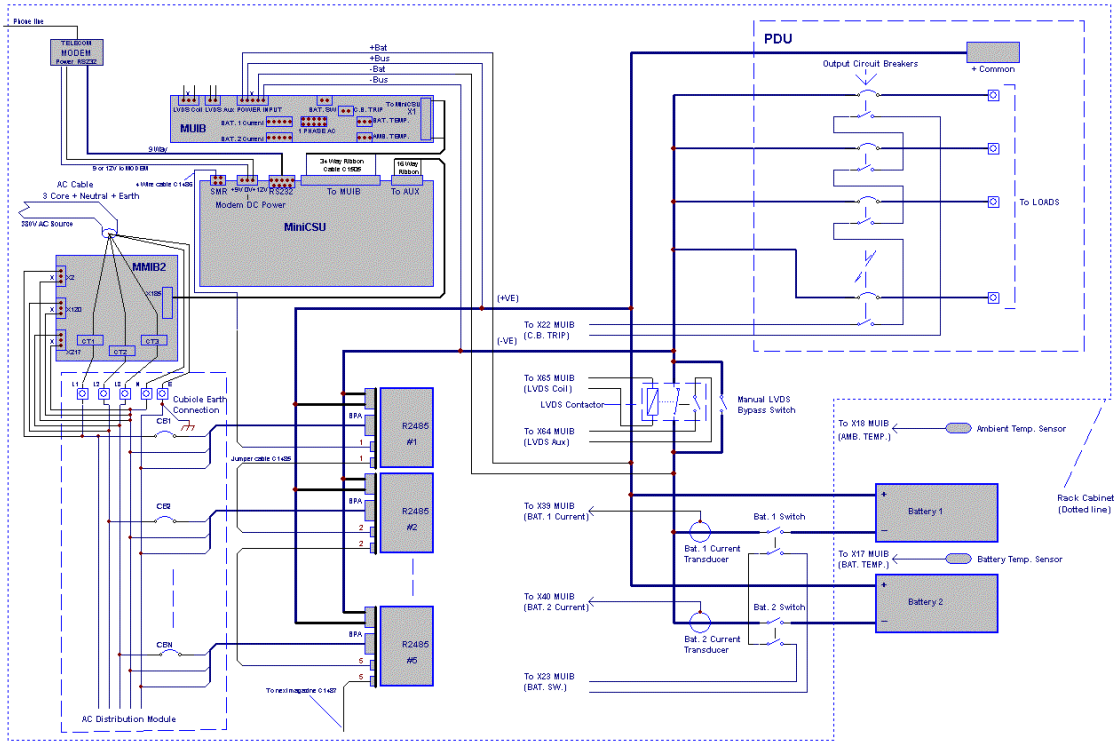


Figure 3.2 Rack Wiring Diagram

AC Module:

A 3U enclosure containing all the AC circuit breakers for the rectifiers, single or three phase active links, neutral links and main protective earth link for connection to the installation AC system. In any system larger than 3kW, it is advisable to balance the loads between all three phases. Consultation of local supply authority requirements is advised.

DC Distribution:

A 3U enclosure containing all the DC load distribution circuit breakers and usually the Battery string circuit breakers. If the Battery breakers are included in the DC distribution module, an isolation barrier is usually required along with clear labeling which battery string the breakers are protecting. The input to the DC distribution module comes directly from the DC output line of the rectifiers that is NOT connected to the system (DC) earth.

LVDS:

A DC contactor capable of breaking the full load/fault current of the batteries when the system voltage falls below the minimum deep discharge level. The LVDS is connected either at the common point of the battery strings or in series with each string to isolate the battery common terminals from the DC line connected to the system earth. The control for the LVDS comes from terminals on the MUIB.

DC Cabling:

The choice of DC cabling and/or busbars is based entirely on the DC current rating of the system. Consult the local National wiring standard for the selection of cable/busbar size for the DC connections. One suggested method of DC cabling for medium systems (~6-8kW) is to provide short 100mm x 6mm busbars at the external DC interface with a number of holes to attach smaller DC cables. Then connect cables up to 25mm^2 from the DC terminations to the output terminals of the individual magazines. The flexibility of the DC cables can be a benefit over fixed busbars when fitting components into a rack with limited space.

Battery Current Transducers:

A Hall effect current measuring unit which is installed over the cable connecting the battery string to its circuit breaker. The signal lines are connected to terminal on the MUIB.

Temperature Sensors:

Modules assembled typically in a copper lug with a mounting hole at one end and sensor cabling running from the other sealed end to terminals in the MUIB. The sensors are normally placed in the battery compartment to measure battery temperatures.

AC Monitoring Module:

An optional module which is available in either single phase or three phase models. The module connects in series with the incoming mains supply by having the phase wires inserted through the current sensors on the module before having the terminating at the active link. The phase-neutral (or phase-phase) voltages are separately sensed by wires connected to terminals on the module (which also provides power to the measurement circuitry). The signals for the single-phase module are connected to the MUIB via a 10-way ribbon cable, while the three phase signals connect directly to the MCSU via a 16-way ribbon.

DC voltage regulation and power for the MCSU is derived from the output DC bus at the point where a constant voltage is most useful. This is typically at the point where the cables run to the batteries. External voltage sensing for voltage regulation at a load can also be done, but in most systems, the system voltage is sensed on the internal output bus. For more information, see the detailed section on the MUIB.

3.5. Rectifier Installation and Removal

In the system, the rectifiers are designed to operate in parallel in a N+1 redundant mode. Therefore, there is never a situation in which it is necessary to set individual rectifier parameters. The only exception is the individual fine adjustment of output voltage used to set up the rectifiers for passive current sharing. This is normally done automatically by the system controller when the system is first commissioned.

The rectifiers are designed to be "hot pluggable" in that they can be plugged into and out of a "live" magazine.

A relay in the output circuit ensures that the rectifier output is only connected to the output DC bus when the difference in voltage between the output bus and the rectifier output is less than 0.5 volts. This ensures that there

is no disturbance to the DC bus when a rectifier is plugged into the magazine. It also prevents damage to the output connector from arcing which would occur if the connection was made with a large voltage difference.

An inrush limiting circuit in the AC input circuit which utilizes a relay and an inrush current limiting resistor limits the disturbance to the AC source to an acceptable level when a unit is plugged in with AC voltage present on the AC bus.

3.6. Removing a Rectifier from the Magazine

Although the connectors are designed to be "hot pluggable" it is advisable to first switch off power to the unit by means of the circuit breaker in the AC distribution module before unplugging the unit. This is done to prolong the life of the "hot pluggable" connector.

Each rectifier has a handle which normally sits flat within the rectifier front panel. The handle must be pulled directly forward to remove the rectifier from the magazine. A "latch" which prevents the rectifier from being removed from the magazine under normal conditions is attached to the handle and releases when the handle is forward(Please refer to Appendix F).

WARNING !!

Take care when removing the rectifier as it may be uncomfortably hot to hold especially if the ambient temperature is high and the unit has been operating at maximum load.

The following please find the right steps for removing a rectifier from the magazine.

Step (1):

Pulling out the handle and meanwhile holding on using fingers to forward smoothly.

Step (3):

Using another hand for holding the bottom of unpluged rectifier carefully.

Step (4):

Removing out the rectifier completely until the back is just clear of the magazine.

Step (5):

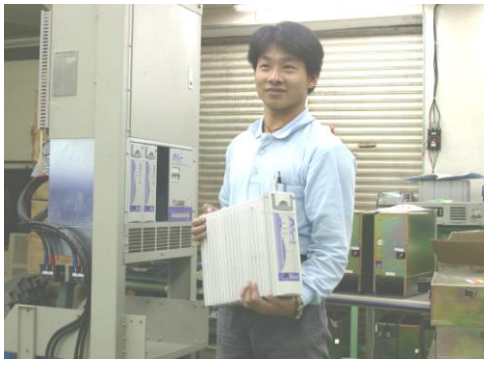
The right way for holding rectifier while moving.

WARNING !!

Don't hold on a rectifier's handle using hand only while moving. This may cause rectifier dropped and the broken handle.

Pulling out the rectifier up to half of unit exposed.

one the



3.7. Inserting a Rectifier into the Magazine

Although the connectors in the unit are designed for "hot pluggability" it is advisable to turn off the AC power to

the input connector by means of the related circuit breaker in the AC distribution module before plugging in the unit.

Hold the unit by the handle provided with one hand and, holding it in the correct orientation by placing the other hand under the unit, place the unit carefully on the guide rails provided and gently slide it into the magazine.

Press the unit into the magazine until it is flush and "clicks" into place. This action has the effect of locking the rectifier in position, so that it will not fall out in the event of severe shaking as might occur in the event of an earthquake.

Switch on the relevant AC circuit breaker in the AC distribution module. The rectifier will start automatically and connect itself to the DC bus at the appropriate time.

The following please find the right steps for inserters a rectifier into the magazine.

Step (1):

Using one hand holds the bottom of the rectifier and meanwhile pulling out the handle.

Step (2):

Plugging a rectifier into the magazine smoothly.

Step (3):

Pushing the rectifier to the end and please make sure the handle which sitsfl at within the rectifier front panel.

Note !!

If operating a rectifier when not inserted in the magazine, or not inserted into its proper magazine, it will only operate at reduced output power (40%) since it senses that there is no fan current (no fan connected).

3.8. MUIB - Mini User Interface Board

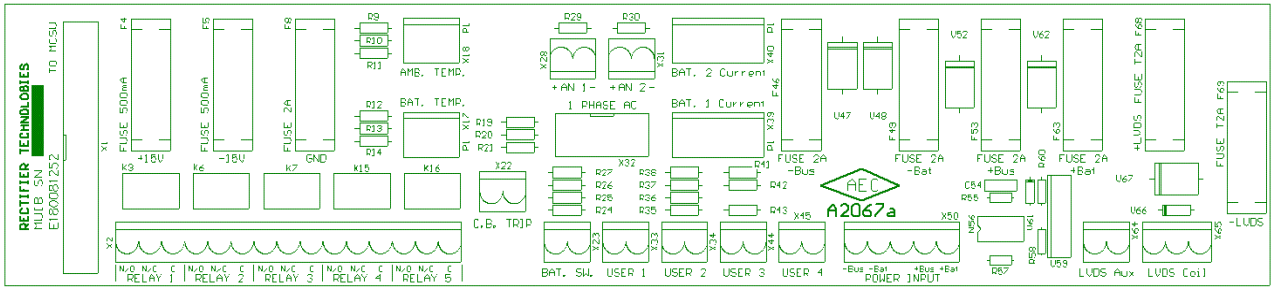
Connections between the MCSU, the external transducers and other inputs are made using the connectors provided on the MUIB, and allow monitoring of a total of two battery currents. Terminals are provided for alarm relay contacts, battery and ambient temperature sensors, two battery current transducers, LVDS control and circuit breaker operation detection using the breaker auxiliary contacts for both the battery and load circuit breakers. A 10-way ribbon cable port is available for direct connection of the optional MMIB1 single phase AC monitor module.

3.8.1. MUIB Connections

The table of **Figure 3.3** give detailed information on the pin-outs of the various MUIB connectors. MUIB outline and detailed connection diagram is given in **Figure 3.4** showing the location and labeling of the connectors on the MUIB. This information is necessary when making various external connections of sensors and control during the system installation. The table of **Figure 3.5** give detailed MUIB connectors function.

Figure 3.3 MUIB Connectors wiring information

Conn	Pin	Signal Name	Conn	Pin	Signal Name
X1 MCSU	1-34	See MCSU Schematic	X28 AN1	1	Positive analogue input - max voltage +5Vdc.
X2-USER	15	N/O relay contact		2	Common of analogue I/P
	14	N/C relay contact	X31 AN2	1	As for AN1
	13	Common		2	As for AN1
X2-FAN SPEED	12	N/O relay contact	X39 BATTERY 1	1	-15V
	11	N/C relay contact		2	+15V
	10	Common		3	No connection
X2-HVSD	9	N/O relay contact		4	Input
	8	N/C relay contact		5	GND
	7	Common	X40 BATTERY 2	1	-15V
X2-ALARM	6	N/O relay contact		2	+15V
	5	N/C relay contact		3	No connection
	4	Common		4	Input
X2-SMR S/D	3	N/O relay contact		5	GND
	2	N/C relay contact	X50 POWER I/P	1	Bat +ve terminal
	3	Common		2	Bus +ve terminal
X17 BAT TEMP.	1	No connection		3	No connection
	2	Sensor -ve		4	Battery -ve terminal
	3	Sensor +ve		5	Bus -ve terminal
X18 AMB. TEMP	1	No connection	X64 LVDS Aux.	1-2	LVDS auxiliary contact
	2	Sensor -ve	X65 LVDS Coil	1-3	Coil driving voltage
	3	Sensor +ve		2	No connection
X22 C.B. TRIP	1-2	Contact closure required between pins 1 and 2	X23 BAT SW.	1-2	Contact closure required between pins 1 and 2
X32 1 PHASE AC	1-10	See 1 phase AC Monitoring module sch.	X33 USER1	1-2	Contact closure required between pins 1 and 2
X34 USER2	1-2	Contact closure required between pins 1 and 2	X44 USER3	1-2	Contact closure required between pins 1 and 2
X45 USER4	1-2	Contact closure required between pins 1 and 2			



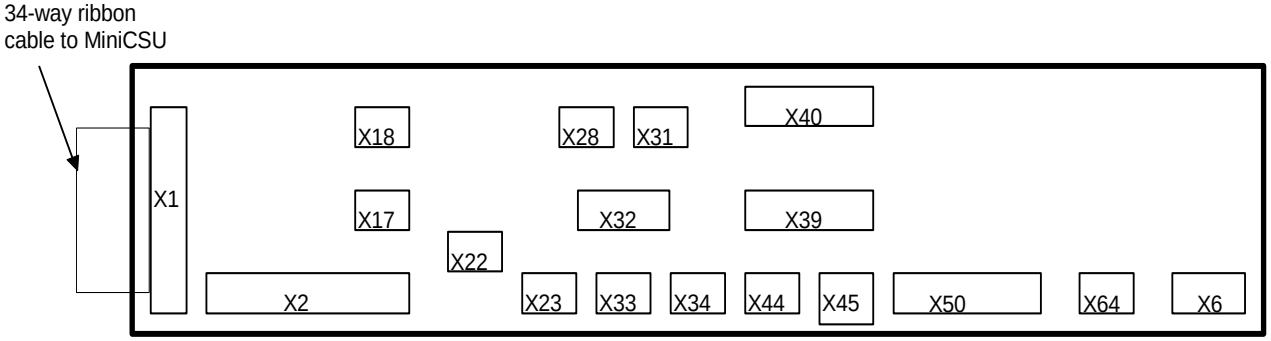


Figure 3.4 MUIB Outline and Connection Diagram

Figure 3.5 MUIB Connectors Function

Conn #	Conn Label	Class	Comments
X1	MCSU	Anal/Dig	34-way ribbon cable to MCSU
X2	USER	Digital	Relay Contacts; N/O, N/C, Common
	FAN SPEED	Digital	Relay Contacts; N/O, N/C, Common
	HVSD	Digital	Relay Contacts; N/O, N/C, Common
	ALARM	Digital	Relay Contacts; N/O, N/C, Common
	SMR S/D	Digital	Relay Contacts; N/O, N/C, Common
X17	BAT. TEMP.	Analog	Temp. Transducer
X18	AMB. TEMP.	Analog	Temp. Transducer
X22	C.B. TRIP	Digital	Aux contact from load CBs
X32	1 PHASE AC	Anal/Dig	10-way ribbon cable from 1 phase AC monitor module
X23	BAT. SW.	Digital	Aux contact from Batt. CBs
X33	USER 1	Digital	User defined i/p; isolated aux. Contact or similar
X34	USER 2	Digital	Requires special software to define function
X44	USER3	Digital	Requires special software to define function
X45	USER4	Digital	Requires special software to define function
X28	AN 1	Analog	Spare analog I/P - 0 to 5VDC
X31	AN 2	Analog	Spare analog I/P - 0 to 5VDC
X39	BATTERY 1	Analog	Battery current transducer
X40	BATTERY 2	Analog	Battery current transducer
X50	POWER I/P	Analog	System voltage sensing and DC power input for MCSU
X64	LVDS Aux	Digital	Aux contact from LVDS contactor
X65	LVDS Coil	Digital	Drive for contactor or similar

3.8.2. Relay Contact Outputs

There are 5 relays with normally open (N/O) and normally closed (N/C) contacts available on the MUIB. Three of the relays are for remote annunciation of alarms (HVSD, ALARM and SMR S/D), while two are for control of external equipment.

One of these two relays for external control (FAN CONTROL) is programmed so that if any one of the SMR heatsink temperatures exceeds a preset (non-programmable) value, the relay closes, indicating a thermal overload. The closure of the relay can be used to increase fan speed or to turn on idle fans where appropriate. In instances where fans are not required, the FAN relay can be used as a secondary USER defined relay.

3.8.3. Spare Digital and Analog Inputs

There are 4 spare digital inputs (USER 1, 2, 3, 4) available on the MUIB for the monitoring of external plant associated with the power supply. The inputs must be isolated relay contacts or auxiliary contacts which are either normally open or normally closed.

There is also provision for monitoring two external analog levels via connectors X28 (AN1) and X31 (AN2) on the MUIB. The analog signals must be in the range 0 to +5VDC and can only be monitored if the single phase AC monitoring module is not connected. This is because the MMIB1 and the spare analog input share the same input lines to the MCSU.

To use the spare analog or digital inputs, or the spare relays, the software for the MCSU must be individually programmed by the manufacturer according to the requirements of the application.

3.8.4. Battery Current Transducer Input

Battery current transducers are connected to X39 and X40 of the MUIB. **Figure 3.6** shows the pin connections for the battery transducer connector going onto the MUIB.

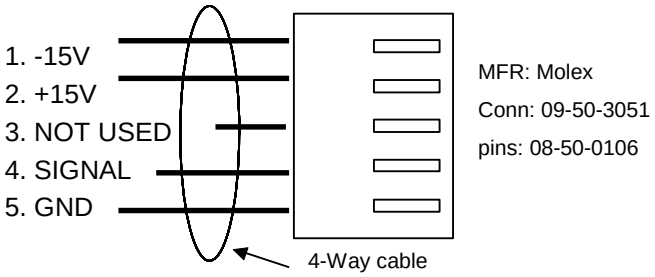


Figure 3.6 Battery transducers connection to MUIB

3.8.5. Main features of MUIB

The principal features of the MUIB are as follows:

- Each battery current input accepts input range of -4V to +4V full scale. The maximum allowed input is ±5V.
- The battery full scale currents are separated so different transducers for battery currents can be used.
- Signal conditioning accuracy for the battery and load currents is typically 1%.
- Actual number of batteries used can be programmed by the user via MCSU front panel or WinCSU remotely.
- There are 5 relay outputs, 4 digital inputs, LVDS interface, CB trip input and Battery switch input.
- Ambient and battery temperature sensors can be connected to this board. When single phase AC monitoring is required, MMIB1 can be used and is also connected to this board.
- The MUIB also provides power to the MCSU, this board can be connected to the bus and battery at the same time.
- Two spare analog inputs are available (input range: 0 to +5V) if MMIB1 (single phase AC monitoring board) is not used.

3.9. MUIB2 - MCSU User Interface Board 2

The MUIB2 is an optional module that may be used in place of the MUIB to allow monitoring of a total of four battery currents and to directly measure one load current. The MUIB2, like MUIB provides basic interfacing between the MCSU and the system environment.

The current transducers are standard 4V full scale. Accuracy of signal conditioning for the current signals are typically 1%. Use of this board also requires a specific MCSU software version and MagMCSU with a different MUIB2 chassis. The software and magazine are backwards compatible with the MUIB.

The addition of the load current transducer input allows the MCSU to sense the load current directly. This provides better resolution of the load current than the calculated current determined from the reported individual rectifier output currents. This is because there is an inherent resolution limit for each rectifier current measurement that can significantly degrade the load current resolution when a system contains a large number of rectifiers. Another use of the load current transducers is when non-AEC rectifiers are used with a MCSU, and these rectifiers do not signal their current to the MCSU. A load current transducer can be used in such situations.

3.9.1. MUIB2 Connections

The MUIB2 connector wiring diagram is shown in the table of **Figure 3.7**, the MUIB2 outline shown in **Figure 3.8** connection diagram in **Figure 3.9**. The table of **Figure 3.10** give detailed MUIB2 connectors function.

Figure 3.7 MUIB2 Connector Wiring Information

Conn	Pin	Signal Name	Conn	Pin	Signal Name
X1 MCSU	1-34	See MCSU Schematic	X28 AN1	1	Positive analogue input - max voltage +5Vdc.
X2-USER	15	N/O relay contact		2	Common of analogue I/P
	14	N/C relay contact	X31 AN2	1	As for AN1
	13	Common		2	As for AN1

Conn	Pin	Signal Name	Conn	Pin	Signal Name
X2-FAN SPEED	12	N/O relay contact	X50 POWER I/P	1	Bat +ve terminal
	11	N/C relay contact		2	Bus +ve terminal
	10	Common		3	No connection
X2-HVSD	9	N/O relay contact		4	Battery -ve terminal
	8	N/C relay contact		5	Bus -ve terminal
	7	Common	X64 LVDS Aux.	1-2	LVDS auxiliary contact
X2-ALARM	6	N/O relay contact	X65 LVDS Coil	1-3	Coil driving voltage
	5	N/C relay contact		2	No connection
	4	Common	X23 BAT SW.	1-2	Contact closure required between pins 1 and 2
X2-SMR S/D	1	N/O relay contact	X33 USER1	1-2	Contact closure required between pins 1 and 2
	2	N/C relay contact	X44 USER3	1-2	Contact closure required between pins 1 and 2
	3	Common	X17 BAT TEMP.	1	No connection
X22 C.B. TRIP	1-2	Contact closure required between pins 1 and 2		2	Sensor -ve
X32 1 PHASE AC	1-10	See 1 phase AC Monitoring module sch.		3	Sensor +ve
X34 USER2	1-2	Contact closure required between pins 1 and 2	X18 AMB. TEMP	1	No connection
X45 USER4	1-2	Contact closure required between pins 1 and 2		2	Sensor -ve
X129 BAT1-Current	1	-15V		3	Sensor +ve
	2	+15V	X103 BAT3-Current	1	-15V
	3	No connection		2	+15V
	4	Input		3	No connection

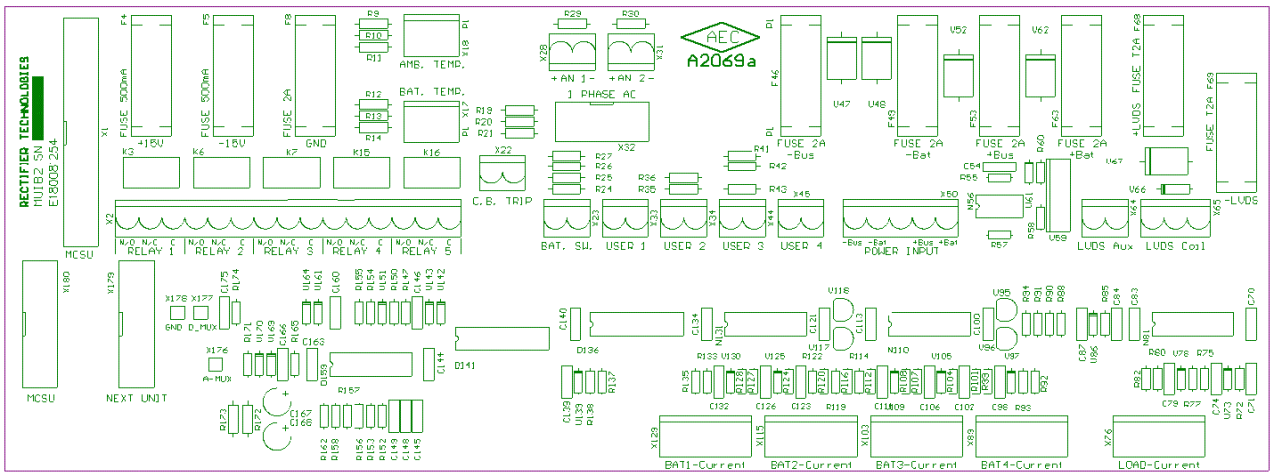


Figure 3.8 MUIB2 Outline

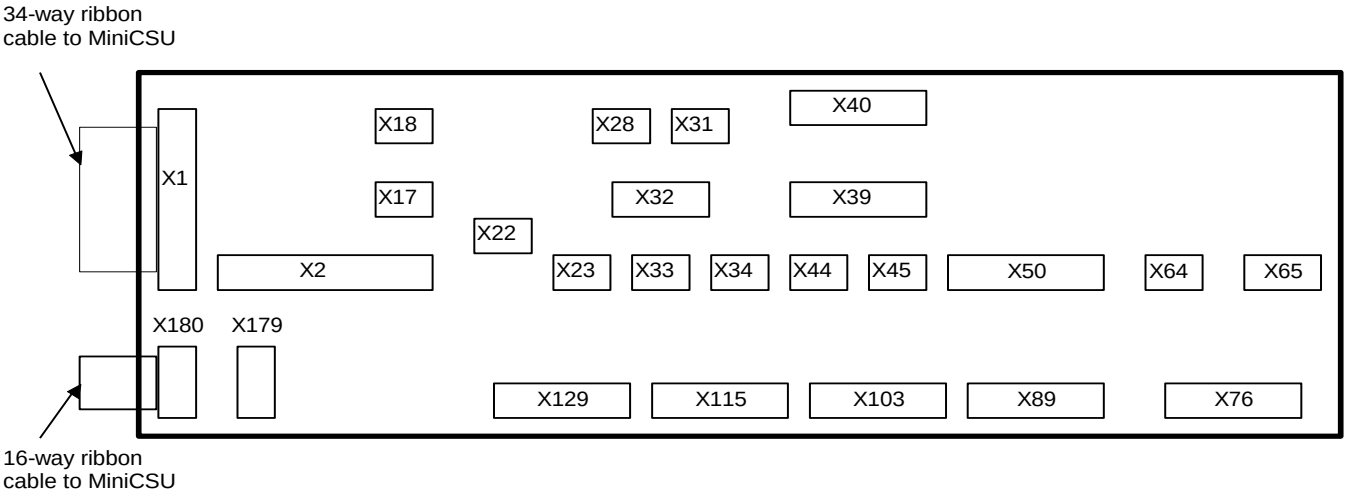


Figure 3.9 MUIB2 Connection Diagram

Figure 3.10 MUIB2 Connectors Function

Conn #	Conn Label	Class	Comments
X1	MCSU	Anal/Dig	34-way ribbon cable to MCSU
X2	USER	Digital	Relay Contacts; N/O, N/C, Common
	FAN SPEED	Digital	Relay Contacts; N/O, N/C, Common
	HVSD	Digital	Relay Contacts; N/O, N/C, Common
	ALARM	Digital	Relay Contacts; N/O, N/C, Common
	SMR S/D	Digital	Relay Contacts; N/O, N/C, Common
X17	BAT. TEMP.	Analog	Temp. Transducer
X18	AMB. TEMP.	Analog	Temp. Transducer
X22	C.B. TRIP	Digital	Aux contact from load CBs
X32	1 PHASE AC	Anal/Dig	10-way ribbon cable from 1 phase AC monitor module
X129	BAT1-Current	Analog	Batt 1 Current Transducer
X115	BAT2-Current	Analog	Batt 2 Current Transducer
X103	BAT3-Current	Analog	Batt 3 Current Transducer
X89	BAT4-Current	Analog	Batt 4 Current Transducer
X23	BAT. SW.	Digital	Aux contact from Batt. CBs
X33	USER 1	Digital	User defined input; isolated aux. contact
X34	USER 2	Digital	Requires special software to define
X44	USER3	Digital	Requires special software to define
X45	USER4	Digital	Requires special software to define
X28	AN 1	Analog	Spare analog I/P - 0 to 5VDC
X31	AN 2	Analog	Spare analog I/P - 0 to 5VDC
X64	LVDS Aux	Digital	Aux contact from LVDS contactor
X65	LVDS Coil	Digital	Drive for contactor or similar
X50	POWER I/P	Analog	System voltage sensing & DC power input for MCSU
X76	LOAD-Current	Analog	Load Current Transducer
X180	MCSU	Anal/Dig	16-Way ribbon cable to Aux Port
X179	NEXT UNIT	Anal/Dig	16-Way ribbon cable to Aux Port

3.9.2. System setup requirement

The original MUIB board is replaced by MUIB2. The chassis has been designed so that it can take either an MUIB or MUIB2 board. Due to the increased size of the MUIB2 board, the maximum width of the modem is reduced from 170mm to 160mm.

The MCSU software needs to be a version with an MUIB2 option. This board needs to be enabled by the appropriate version of MCSU software from the front panel of the MCSU or WinCSU. The load transducer also needs to be enabled or disabled as necessary. The full scale value of battery and load transducers then needs to be entered.

3.9.3. Main features of MUIB2

The principal features of the MUIB2 are as follows:

- Each battery current input accepts input range of -4V to +4V full scale. The maximum allowed input is ±5V.
- The load current input range is from 0V to +4V. The maximum allowed input is 0 to +5V.
- The battery and load full scale currents are separated so different transducers for battery and load currents can be used.
- Signal conditioning accuracy for the battery and load currents is typically 1%.
- Actual number of batteries used can be programmed via MCSU front panel or WinCSU remotely.
- Load transducer can be switched on or off via MCSU front panel or WinCSU remotely.
- When the load transducer is switched off, MCSU automatically reverts back to calculating load current using SMR and battery currents.
- There are 5 relay outputs, 4 digital inputs, LVDS interface, CB trip input and Battery switch input.
- Ambient and battery temperature sensors can be connected to this board. When single phase AC monitoring is required, MMIB1 can be used and is also connected to this board.
- The MUIB2 also provides power to the MCSU, this board can be connected to the bus and battery at the same time.
- Two spare analog inputs are available (input range: 0 to +5V) if MMIB1 is not used.

3.9.4. Connections to MCSU

Two ribbon cables connect between MUIB2 and MCSU. One 34-way ribbon cable for the main port connects X1 on MUIB2 to MCSU. The other 16-way ribbon cable connects X180 or X179 on MUIB2 to the aux port on MCSU. Since all devices connected to the aux port are in parallel, it can be connected to any point on the aux port.

Note: The connection of the 16-way ribbon to X179 or X180 must be made if any of X76, X89, X103, X115, or X129 are used.

3.9.5. Load Current Transducer Input

A load current transducer is connected to X76 of the MUIB2 via a connector using the pin connections shown in **Figure 3.11**.

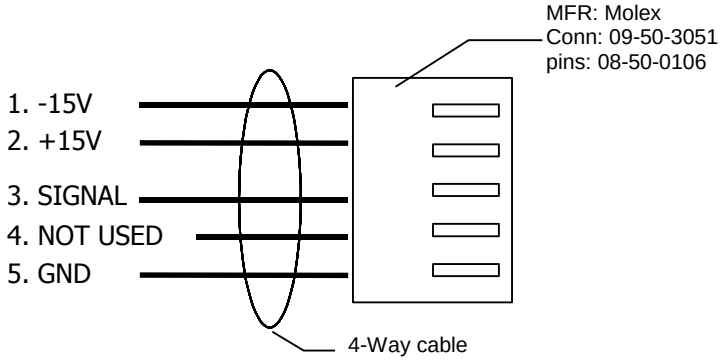


Figure 3.11 Load transducer pin connection for MUIB2

3.10. Power Input

Power to a MCSU is connected to this MUIB/MUIB2 via connector X50. Pin designations are also labeled on the PCB as well. Both the bus and battery voltages are connected to the MCSU via this connector. The MCSU takes power from either the battery or bus depending on which voltage is higher. The system voltage is read by the MCSU via the bus terminations of this connector.

3.11. CB Trip, Batt SW and LVDS Aux inputs

CB Trip (X22) is used to sense the CB status. Batt Sw (X23) is used to sense status of battery switch. LVDS Aux (X64) is used to sense the status of the LVDS switch. Open contacts on any of these 3 input creates an alarm condition on the MCSU, therefore, when any of these 3 inputs are not used, a shorting plug should be installed on those not in use.

3.12. MMIB1 input

MMIB1, the single phase AC monitoring board is connected to connector X32. This board must not be connected if the two additional analog inputs X28 and X31 are in use. The reverse is also true, that the two additional analog input AN1 (X28) and AN2 (X31) must not be connected to anything when the MMIB1 is connected. Refer to MCSU technical manual for more information about MMIB1.

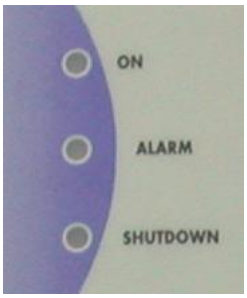
4. Commissioning

Commissioning primarily requires an understanding of the rectifier visual signals and operator adjustable parameters on the system controller (MCSU). Before a system is first energized, it is advisable to read this section thoroughly.

4.1. Indicators on the Rectifier Front Panel

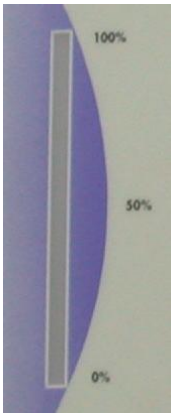
There are three LEDs on the front panel to indicate the operating status of the rectifier modules. They are as follows:

	LED Name	LED Colour	What it indicates
1	ON	Green	Rectifier functioning normally
2	Alarm	Yellow (flashing)	Alarm condition
	Alarm	Yellow (not flashing)	Unit is in Equalization mode
3	Shutdown	Red (with yellow LED flashing)	Unit is switched off or failed
	Shutdown	Red (yellow LED not on or flashing)	Micro in SMR has failed



If necessary, further information about the particular rectifier alarm condition, if one exists, can be found by referring to the MCSU or the PC connected to the MCSU.

4.2. Output Current Bar-graph



A 10 segment LED bar-graph display can be included in the front panel of the unit as an option to indicate the output DC current. Each element of the bar graph represents one tenth of the rated current of the rectifier.

4.3. Fan DC power

The nominal 12VDC required to operate the fan at the bottom of the magazine associated with each rectifier is derived from a two way connector on the magazine back-plane PCB (BPA2). The two lines used to provide DC power to the fans is also used by the rectifier control microprocessor to sense the magazine position resistor on the magazine back- plane. A different resistor value is used in each magazine position (up to 15 different positions) to identify that position. A circuit consisting of only a few components is used enable the microprocessor to achieve both functions.

The DC voltage to the fan is varied by the control microprocessor according to need. At loads up to 10 amps, the fans are off. At current s greater than 10A each fan is driven at a voltage proportional to load current with full voltage applied when the load is greater than 47.5A or when the heat-sink temperature is greater than 50°C.

4.4. System Commissioning

To commission a system, modification of system parameters on the MCSU is required. This can be done manually through the front panel of the MCSU, or by using a PC running WinCSU that is connected to MCSU via the RS-232 serial interface. It is assumed that the operator commissioning the system has a knowledge of programming system parameters.

The system parameters can vary widely depending on the system configuration and battery requirements. It is advisable to consult the battery data sheets as a reference when determining the system parameters to be programmed into the MCSU.

4.4.1. Commissioning Procedure

With a newly installed system with batteries and load, the commissioning procedure is as follows:

- Make sure there is no load on the DC bus and that the batteries are disconnected.
- Insert a rectifier into the top left position (SMR 1) in the system and turn the AC power on. The rectifier should

power up and start the MCSU.

- Using either the MCSU front panel or a PC connected to the RS-232 serial port, program all the MCSU parameters according to the system requirements. Make sure that the number of rectifiers in the system is correctly set. It is recommended for systems that are to be commonly commissioned that the PC option be used. The benefit being that predetermined configurations can be stored on disk and easily downloaded to the MCSU at any time.
- Set up any parameters necessary to operate auxiliary equipment such as Battery Cell Monitor (BCM), Mains Monitoring Interface Board (MMIB), Site Monitor, etc.
- Put all the remaining rectifiers 'on-line', one at a time by inserting the rectifier into the magazine and switching on the corresponding AC breaker where necessary. Check that each unit powers up and communicates with the MCSU. This is determined by checking that the MCSU has a message window corresponding to the rectifier number similar to "SMR2 0A".
- With all rectifiers operating correctly, add a load to the system of at least 30% of the rated system current.
- Check that the MCSU performs a passive current sharing adjustment by noting the appearance of an "$\overline{X}$" at the end of the LCD display.
- Increase the load to 100% and check that the rectifiers all share load current.
- Reduce the load to 75% and burn in for 24 hours.
- Remove the load. Connect the batteries on-line and allow to charge before bringing final system on-line.

For further information on any subject relating to MCSU operation or alarms, see the detailed section on MCSU. Below is a listing of the range of the system parameters that are accessible when commissioning a system.

4.4.2. System Parameter Ranges

Adjustable System Alarms:

Alarm	Range	Steps
Voltage high alarm	52.0-66.0V	0.1V
Voltage low alarm	40.0-54.0V	0.1V
Battery discharge alarm	44.0-52.0V	0.1V
Ambient temperature high alarm	30-90°C	1°C
Battery temperature high alarm	30-90°C	1°C
Differential battery discharge current	5-99A	1A

AC Supply Monitoring Alarms: *Available when optional module is used.

Alarm	Range	Steps
AC supply high voltage alarm	220-315V	1V
AC supply low voltage alarm	140-270V	1V
Frequency high alarm	50-65Hz	0.1Hz
Frequency low alarm	40-60Hz	0.1Hz

Adjustable SMR Alarms:

Alarm	Range	Steps
SMR voltage high alarm	52.0-65.0V	0.1V
SMR voltage low alarm	44.0-54.0V	0.1V
SMR HVSD	54.0-66.0V	0.1V

Battery Equalization Parameters:

Automatic equalization of the battery with selectable start and end parameters;

Parameter	Range	Steps
Equalize start voltage	44.0-50.0V	0.1V
Equalize voltage	50.0-61.0V	0.1V
Equalize start discharge AH	5-99AH	1AH
Equalize time duration	3-48Hrs	1Hr
Equalize end battery current	**	1A
Periodic equalize interval	1-52weeks	1week

** Current range limits are based on user defined parameters: = (10% of BatILim3 OR 3% of Sensor FSD) - 20% of Bat. AH

Note: On units with software version R2485xx and higher, equalization can be disabled

Battery Cell Monitoring Alarms:

Available when optional module is used. Batteries built of different types of cells can be used. 4V, 6V or 12V monoblocks can be monitored as well as single 2V cells.

Alarm	Range	Steps
Cell Low Voltage Alarm	1.0-12.0V	0.01V
Cell High Voltage Alarm	2.0-16.0V	0.01V
Cell Positive Deviation Alarm	5-99%	1%
Cell Negative Deviation Alarm	5-99%	1%

Battery Charging Parameters:

Parameter	Range	Steps
Deep discharge range limit (Vdd)	40.0-47.0V	0.1V
Float charge range limit (Vfl)	48.0-58.0V	0.1V
Battery current limit range below Vdd	5-999A	1A
Battery current limit between Vdd & Vfl	5-999A	1A
Battery current limit above Vfl	5-999A	1A
Battery (V) temp. compensation (BTC)	0-6mV/°C/cell	0.1mV
Zero BTC voltage set point temp.	18°C-27°C	1°C
BTC operating range	10°C-35°C	-

LVDS Parameters:

Parameter	Range	Steps
Trip level range	40.0-47.0V	0.1V
Reconnect level	Vfloat - 1V	-

Other System Parameters:

Parameter	Range	Steps
Batt. current transducer full scale current	10 - 9990A	10A
Load current transducer full scale current	50 - 9990A	10A
Batt. current transducer full scale voltage	±4V	-
Load current transducer full scale voltage	+4V	-
Number of Batteries (using MUIB2)	1-2 (4)	1
Load current transducer (activation)	ON/OFF	-
Battery capacity	20-9999AH	1AH

Battery Discharge Test:

Parameter	Range	Steps
BDT Period (Days)	Off, 1 - 365	1 day
BDT Time (24 Hour Format)	00:00-23:59	1 min
BDT Duration (Hours : Minutes)	0:05-24:00	1 min
BDT Current	0 – 5000A	1A
BDT End Capacity (Q)	25–9995AH	1AH
BDT End Voltage	36 – 48V	1V

R2485-48V/50A SMR Parameters

Parameter	Range	Nominal
SMR Float Voltage	48 to 59V	54.0V
SMR Equalize Voltage	50 to 61V	55.0V
High Voltage alarm Threshold	52 to 65V	56.0V
Low Voltage alarm Threshold	44 to 54V	48.0V
HVSD Voltage alarm Threshold	54 to 66V	57.5V
Current Limit for SMR	5 to 52A	52A

5. Operation

System operation is generally controlled by the MCSU system controller. As a result, operation information for the system is directly related to the operation of the MCSU as described in this section.

5.1. Summary of MCSU front panel controls

There are four Menus which can be viewed using the INC or DEC buttons:

a) The default or "Home" menu which contains general system information;

b) SMR menu - contains all the parameters regarding to the rectifiers;

c) Battery menu - contains all the parameters regarding the batteries;

d) Alarms log - which is a chronological record of the last 100 alarms.

Moving from one menu to another

If no button has been pressed for two minutes, the display will revert back to the Home screen. This shows the output voltage and current.

To move from any menu to any other menu, press the corresponding button. E.g. to move to the Battery Menu from any other menu, momentarily press the BATT button.

To move to the Home menu from any other menu, press the button of the current menu. E.g. if in the SMR menu, press SMR button to return to the Home menu.

Scrolling through the Menus:

To scroll through any menu from the first screen to the last, press the INC button;

To scroll to the last (bottom) screen first, then upwards through the menu to the first screen, press the DEC button.

Incrementing and decrementing programmable parameters

To change a programmable parameter press ENTER; the value will flash on and off. To increase the number, press INC; to decrease the number press DEC. When the desired number is on the screen, press ENTER again.

To change parameters when the security function is activated

If an attempt is made to alter any parameter when the security function is activated, the display will show the message "Panel Locked".

To change a parameter, simultaneously press all three INC, DEC and ENTER buttons for three seconds. Then proceed to change the parameter in the normal way.

When scrolling through the Alarms log

To observe the date and time of a given alarm, do not press any button for at least two seconds. The date and time will display for two seconds and then the alarm name will be displayed for two seconds. The display will alternate between the two screens in this manner until a button is pressed.

5.2. MCSU Components

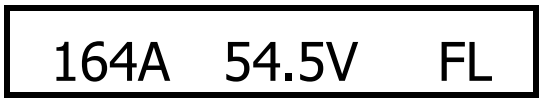
The MCSU is a supervisory and control unit for a DC plant comprising up to 15 rectifiers connected in parallel with two parallel battery banks.

The unit is 1U in height and a magazine is available which fits across a 19” rack and accommodates the MCSU, the MUIB as well as a modem of maximum dimensions 40x150x220 (HxWxD in mm).

5.2.1. Alpha-numeric LCD Display

A single line 16 character alphanumeric back-lit display with large 9mm high characters normally displays output

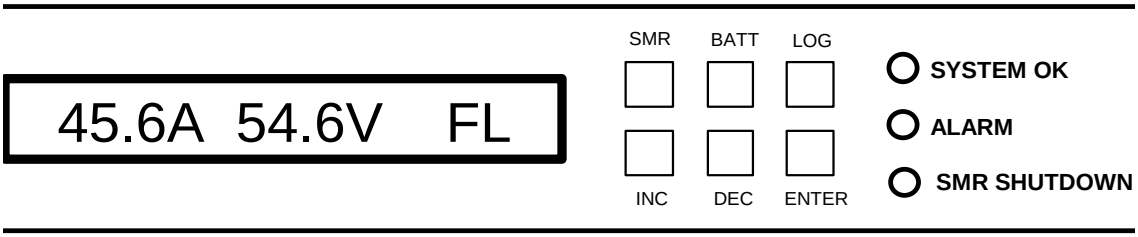
voltage and current as well as the system status - Float (FL) or Equalize (EQ). This is the default or "home" screen.



Whenever there is no push-button activity for more than 40 seconds, the display always reverts to this home screen. Note: the examples shown is for 48V systems.

5.2.2. Front Panel Pushbuttons

There are pushbuttons associated with the LCD screen for the purpose of entering different Menus and for scrolling through the menus. The layout of the pushbuttons is shown below:



Apart from the MCSU or "Home" menu, which includes mostly system oriented parameters, there are three other menus which can be accessed by momentarily pressing the relevant pushbuttons:

a) **SMR** menu, which includes the rectifier related programmed parameters as well as the output current and heat-sink temperature for each rectifier;

b) **Batt**ery menu in which all the parameters appertaining to the batteries are found;

c) **Log** which stores all the individual alarm information together with date and time starting with the most recent alarm. A total of 99 alarms are stored in memory.

5.2.3. Status Indicating LEDs(MCSU)

In addition to the alphanumeric display there are also three LEDs to indicate system status as follows:

SYSTEM OK	Green
ALARM	Amber
SMR SHUTDOWN	Red

When all three LEDs are off, the unit is off and there are a number of possible reasons for this. For example:

- DC is not present
- Internal failure of MCSU

The amber LED indicates any alarm condition, either system or rectifier related.

The red LED indicates that one or more of the rectifiers in the system is shut down.

5.3. Operating the MCSU

5.3.1. Entering and moving through different Menus

To scroll through the MCSU menu from top to bottom, just press the INC button. If the DEC button is pressed, the screen at the bottom of the menu will appear first and will be followed by the other screens in reverse order. This can be useful when it is desired to access a screen near the bottom of the menu.

To enter the other menus, momentarily press the relevant button - SMR, BATT or ALARM LOG. If at any time it is necessary to return to the MCSU or "home" menu, just press the current menu button once. E.g. if the present menu being scrolled is BATT, just press BATT button again and the screen will return to the default "home" screen.

The INC and DEC keys are also used to increase or decrease parameter values when the parameters are programmable.

In this case, press ENTER first. The parameter value will begin flashing on and off. Press INC to increase the value

or DEC to decrease the value until the desired value is obtained. Then press ENTER again to actually enter the value into memory.

5.3.2. When an alarm condition exists

If one or more alarm conditions exist at any time the following message will alternate with the "home" screen for 2 seconds every six seconds in addition to warning LED indicators:

3 Press ENTER

In this case, the message indicates that there are three alarms present and they can be observed by pressing the ENTER button.

When the ENTER button is pressed the most recent alarm name, such as the one shown below will appear on the display.

1 Battery Switch

If the ENTER button is not pressed again for ten seconds, the display will revert to the "home" screen and the sequence begins again.

To view the remaining alarms, use INC and DEC buttons. ENTER returns to the home screen. Pressing the ENTER button a fourth time will return the display to the "home" screen.

The time and date of any given alarm can be obtained by entering the ALARM LOG menu.

5.4. MCSU Alarms

A list of all the possible alarms which can be enunciated is shown in the following table.

Alarm Name	Comments	LED
SMR Alarm	Combination of one or more SMR alarms	A
SMR Alarm-Urgent	One or more SMRs have shut down	A+R
SMR HVSD	SMR shut down due to output over-voltage	A+R
UNIT OFF	SMR is off	A+R
No Response	A particular SMR is not responding to the MCSU	A
Power Limit	SMR is in Power Limit	A
No Load	SMR output current less than minimum for SMR type used	A
Current Limit	SMR in current limit	A
Volts High	Voltage measured by SMR too high	A
Volts Low	Voltage measured by SMR too low	A
EEPROM Fail	EEPROM failed (CSU or SMR)	A
No Demand	Control loop in SMR not in normal state	A
H/S Temp High	SMR heatsink temperature too high (where available)	A
DDC Controller	SMR DC/DC converter fault	A+R
Temp Sensor Fail	Temp sensor in SMR faulty - S/C or O/C (where available)	A+R
Reference Fail	Voltage reference in SMR microprocessor circuit faulty	A+R
HVDC not OK	DC/DC converter (boost) voltage in SMR not OK	A+R
High Volts SD	Shut-down of SMR due to output volts too high	A+R
AC Fail	None of SMRS are responding (AC fail assumed)	A+R
Temp Sensor N/A	Temp sensor in MCSU not plugged in	
Battery Switch	One or more battery switches open	A
Cct Breaker	Fuse or CB in load distribution open	A
LVDS Open	Low Voltage Disconnect switch open	A
Sys Volts High	System output volts too high	A
Sys Volts Low	System output volts too low	A
Battery Disch	Batteries are discharging	A
SMR Comms Fail	One or more of SMRs are not responding	A

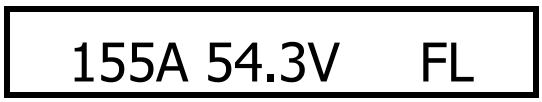
Alarm Name	Comments	LED
AC Volt Fault	AC voltage lower or higher than preset value. (When no AC monitoring module is used, this comes together with "SMR Comms Fault")	A+R
AC Freq Fault	AC frequency lower or higher than preset value	A
Amb Temp High	Ambient temperature higher than preset limit	A
Batt Temp High	Battery temperature higher than preset limit	A
Batt I-Limit	Battery charging current is being limited to preset value	A
Batt Dis Fail	Battery discharge rate greater than that preset	A
Earth Leakage	Earth leakage current greater than the limit set	A
Equalize	System is in equalize mode	A *

R = red LED on A = amber LED flashing * not flashing

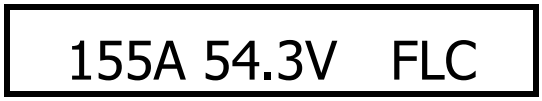
5.5. MCSU Home Menu Screens

The INC button is pressed to scroll through the MCSU menus. The following screens will appear in sequence.

MCSU "Home" screen; indicates system is in float mode.



"C" indicates that battery temperature compensation function is active.

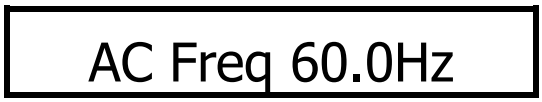


Ambient temperature is displayed in Degrees Centigrade.

AC Volts for single phase monitoring *

AC Current for single phase monitoring *

AC Frequency for single phase monitoring *



*The last three screens are only displayed if "Expan 1 AC 1-ph" is selected - see screen towards the end of this menu. This will be the case if a system is wired with only the MMIB1 module connected. Single phase monitoring is not available in 110VDC and 220VDC systems.

5.5.1. Three-Phase AC Monitoring Screens

In a system wired for 3 phase input, it will be necessary to set the 3 phase AC monitoring selection screen (towards the end of this menu) to "Expan2 3 ph AC " instead of "Expan2 None". In this instance the following screens will appear in place of the single phase AC monitoring screens:

AC voltage of phase 1

AC voltage of phase 2

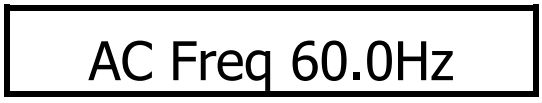
AC voltage of phase 3

AC Current of phase 1

AC Current of phase 2

AC Current of phase 3

AC Frequency



5.5.2. Home Menu Programmable Parameters

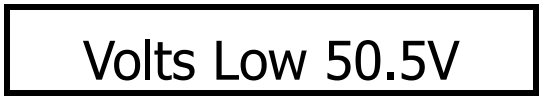
The screens below all display programmable parameters within the MCSU home Menu. To change a parameter, press INC button until the desired parameter is found, then press ENTER. The parameter value will flash on and off. Press INC to increase the value or DEC to decrease the value until the desired value is on the screen.

Press ENTER to enter the value into memory.

Ambient temperature alarm level

Float voltage High level

Float voltage Low level



Security on or off. When security function is activated attempts to alter any programmable value will result in the display showing "Panel Locked". To temporarily unlock the system press all three INC, DEC and ENTER buttons simultaneously for three seconds. The system reverts back to the locked state if no button is pressed for longer than 2 minutes.

System type. This parameter can be set to Standby or UPS. Set to Standby for systems where the load current is normally zero. Low load alarms are disabled for Standby .Set to UPS for systems which typically have more than 20% load all the time, and rely on the batteries to provide backup power.

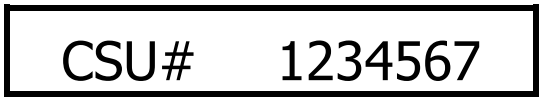
Test function. When this function is activated, all LEDs on the rectifiers and MCSU begin flashing on and off. The display
alternates between showing the software version and a screen with all pixels on.

Number of SMRs in the system. This number must be entered otherwise the display will show that some SMRs are not responding.

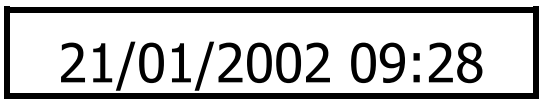
Number of battery banks in the system

DC transducer full scale rating. E.g. if a Hall transducer has 200A/4V rating, enter 200 in the screen.

MCSU Access code address; this can be a number up to 7 digits long



Clock set; used to set the date and time of the MCSU clock. Note DD/MM/YYYY 24 hour clock



Modem enable; this can be toggled between ON and OFF.

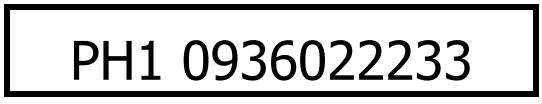
The screens below will only be displayed if the modem is enabled (ON)

Alarm Report; this can be toggled On and OFF. If ON the system will dial the first telephone number (Phone 1) in the screens below when an alarm occurs. If Phone 1 does not. answer, it will try Phone 2; if 2 does not answer then it will dial Phone 3. If 3 does not answer it will begin again at Phone1

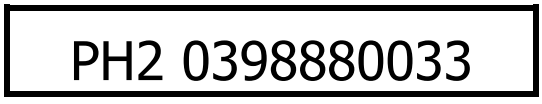
Daily Report; this can be toggled from ON to OFF; When ON, the system will log in to the telephone numbers below at the
time set in the following screen and download the. status and all the operating parameters

Time of daily report

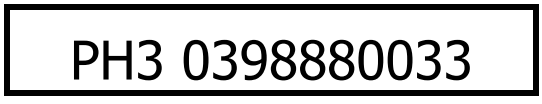
Phone 1; number tried first when an alarm occurs. Numbers up to 20 digits long can be stored. If the number is longer than 10 digits, it is displayed in two screens. Example of second screen for continuation of phone number.



Phone 2; this number will be tried if the first number does not respond



Phone 3; this number will be tried if the second number does not respond .



Note: To have Alarm Report and/or Daily Report sent to local PC, switch the Reports ON, then Modem Off

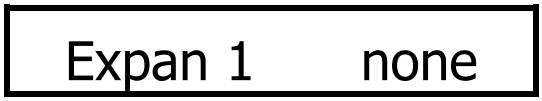
Audio Alarm Enable; can be toggled from On to Off; when On, the audible alarm will sound when any alarm occurs. The
sound can be silenced by pressing the ENTER button.

5.5.3. Expansion Function Selection & Parameters

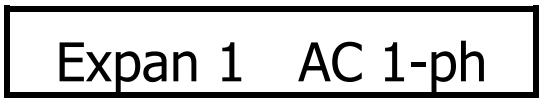
The enabling/disabling of expansion functions such as AC monitoring, Battery Cell Monitoring and Site Monitoring is described below. These screens form the last screens seen when stepping through the MCSU home Menu.

Single Phase AC Monitoring

Selection of expansion function 1; when selected, this enables the single phase monitoring screens as well as the screens below.



Note that Expansion 1 is not available in 110VDC and 220VDC systems.



High AC voltage threshold; "ACV Hi" alarm will appear when the AC input voltage is higher than this level; the rectifier will
switch off independently at some level. It will turn on again when the AC level falls to an appropriate value.

Low AC voltage threshold; "ACV Lo" alarm will appear when the AC input voltage is lower than this level; the rectifier will
switch off independently at some. It will turn on again when the AC level rises to an appropriate level.

AC frequency high level; this alarm is generated when the AC source frequency is higher than this value; the rectifier does
not switch off;

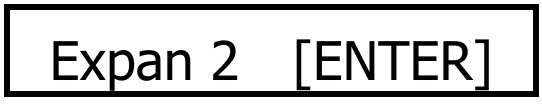
AC frequency low level; this alarm is generated when the AC source frequency is lower than this value; the rectifier does
not switch off.

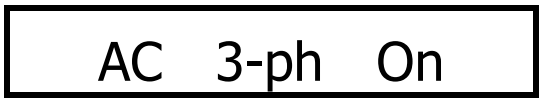
AC current sensor rating for single phase; the full scale rating of the AC sensor must be entered in this screen.

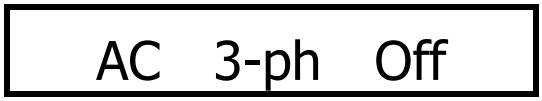
3 Phase AC Monitoring

When the three phase monitoring module is used in the system, the relevant screens are activated by programming to On the 3 Phase AC in Expan 2 section. If programmed to "none" neither the monitoring nor the programmable parameter screens shown below will be displayed.

3 phase AC monitor On or Off can be selected after entering "Expan 2" sub-menu







AC voltage high level; if any one of the three phases is higher than the level programmed here, the MCSU will report an
AC Volt Fail alarm;

AC voltage low level; if any one of the three phases is lower than the level programmed here, the MCSU will report an AC Volt Fail alarm;

AC Frequency high level; if the AC source frequency is higher than this value, the MCSU will report an AC Freq Fail alarm

AC frequency low level; if the AC source frequency is lower than this value, the MCSU will report an AC Freq Fail alarm

AC current sensor rating for 3 phase monitor; the rating for the sensors used (current transformers) must be entered in this screen.

Battery Cell Voltage Monitoring

When Battery Cell Voltage Monitor is included in software, the next window enables the turning ON or OFF of the battery monitoring function.

Press Enter and the Off word will flash on and off; press DEC button and On will appear, flashing on and off. Press ENTER
and Battery monitoring function will be turned on. The windows which follow do not appear if the function is switched off.

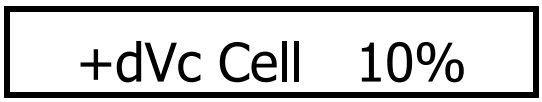
Press INC to scroll to next window. The battery configuration must now be entered. The configuration refers to cell type (2, 4, 6 or 12V) and how the cells are connected to the monitor. After pressing ENTER, current configuration will flash. Scroll through available configurations and press ENTER again once the correct battery type is chosen.

Declare number of battery banks to be monitored. Maximum is 4.

Scroll to the next window to set a high voltage threshold for cell voltage. An alarm is posted if any cell voltage exceeds this value. Press ENTER and increment or decrement the value as desired in the normal way

Similarly a low threshold can be set for the cell voltages. If during a discharge (or any time) a cell voltage falls below this
value, an alarm is raised.

+dVc is a differential voltage threshold. It is the percentage voltage by which the voltage of a particular cell exceeds the average cell voltage for the whole battery.



Scroll to the next window to set -dVc, the low differential cell voltage threshold.

Site Monitor

The site monitor is primarily designed to be operated with WinCSU from a PC. However, once set up the analog signal levels can be viewed and the alarm levels and scale factors can be modified from the site monitor sub-menu of the MCSU.

The site monitor sub-menu is a sub-set of 'Expansion 2'. When Site Monitor is declared to be Off, no other menu items are displayed.

Site monitor menu as appears in the Expansion 2 menu. Press ENT to access the site monitor sub-menu.

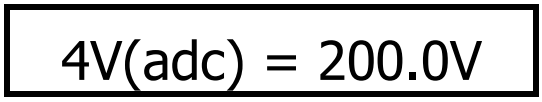
Active or de-activate the site monitor by pressing ENT to make On/Off flash. Press INC or DEC to change state. When not flashing, press INC or DEC to view all input levels or states.

Level of Analog input 1. Press ENT to access alarm levels and scaling factor. Flashing of the label text (in this case 'Inverter') indicates an alarm condition.

Threshold above which the input signal will trigger an alarm.

Threshold below which the input signal will trigger an alarm.

Programmed scale factor of analog input. Scaled for 4V of input signal.



Digital input signal levels only can be accessed from MCSU. To modify the logic or the label of the digital inputs, the units or labels of the analog inputs, a PC running WinCSU must be used.

5.6. SMR Menu Screens

All information relating to the individual rectifiers is found in the menu activated by pressing the SMR button on the MCSU front panel. To return to the MCSU menu at any time, press SMR button. To return to the SMR menu, press the SMR button again.

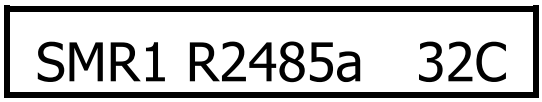
When an SMR is not connected or not switched on or is faulty, the screen indicates that the rectifier is not responding.

Warning: It is important to declare the correct number of rectifiers in the rack using the MCSU home menu.

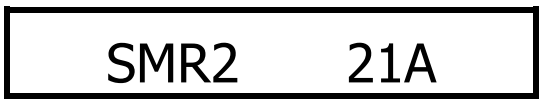
NOTE: Output current and limit values shown below are typical for a 25A unit.

SMR1 Current: When a rectifier is on line and operating normally, its output current is displayed.

Pressing ENTER once displays the version number of the SMR and heatsink temperature. Press ENTER again to revert to first screen.



Use INC button to display the output current from the other rectifiers.



The rest of the SMR menu consists of screens detailing the SMR operating parameters.

Float Voltage value. This parameter is globally (and indirectly) set in the BATT menu so cannot be changed in this
screen. It is set automatically to a value equal to the sum of the Sys Float and Sys Drop values set in the BATT menu.

As with the Float Voltage value, the Equalization Voltage parameter is globally (and indirectly) set in the BATT menu so cannot be changed in this screen. It is set automatically to a value equal to the sum of the Sys Equal and Sys Drop values set in the BATT menu.

If "ENTER" is pressed while viewing above 2 screens, the following message will appear.

5.6.1. SMR Menu Programmable Parameters

The remaining screens show the SMR related operating parameters which can be changed by pressing ENTER. When this is done, the number flashes on and off and can then be incremented or decremented by pressing the INC or DEC buttons respectively. When the correct value is obtained, press ENTER to enter the number into memory.

SMR high voltage alarm level.

SMR low voltage alarm level.

SMR DC High Volts Shutdown (HVSD).

SMR Current Limit.

Fault Reset; by pressing ENTER when this screen is displayed, any latched alarm, such as HVSD, is reset and the
unit will restart unless it is damaged or faulty.

Please note that any parameter change will apply to all the SMRs.

5.7. Battery Parameter Menu Screens

All information pertaining to the batteries is accessed by momentarily pressing the **Batt** button on the front panel. To return to the MCSU "home" menu at any time, momentarily press the **Batt** button.

As for the other menus, in general a programmable parameter can be incremented or decremented by use of the INC and DEC buttons respectively. If this is attempted when a monitored parameter is being displayed (i.e. not a programmable operating parameter), then the message "Not Adjustable" will be displayed.

The following screens will appear in turn when the INC button is pressed:

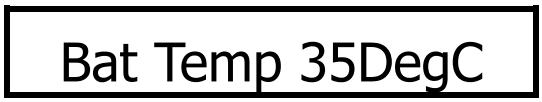
Battery 1 Current;

Battery 2 Current; (if present)

This screen is available During an AC power outage when the batteries are supplying the load, the difference in discharge
current between one battery and the other is an indication of the state of the batteries. More particularly, if one battery is supplying considerably less current than the other, it is usually an indication that a problem exists with that battery. The discharge current difference to activate the alarm is entered in this screen. A reasonable value is 20% of the total discharge (load) current.

Batteries discharging is unequal; if one of the two batteries supplies less current than the other by more than a programmed amount.

Battery Temperature; If a sensor is fitted, the battery temperature is shown in degrees Celsius. (Since there is provision for only one sensor, the sensor should be located in the hottest spot of the two batteries.) If the temperature sensor is not connected, the message reads as shown (sensor not attached); When Bat Temp Sensor condition alarm is selected, this screen will show:



Battery over temperature alarm level. This is a programmable level and can be adjusted in the normal way by the INC, DEC and ENTER buttons.

Estimated Battery 1 state of Charge; this screen shows the estimated charge in the battery at any given time.

Estimated Battery 2 state of Charge. (if present)

Ampere-hour rating of batteries; the rated A/H number for the batteries must be entered in this screen.

Battery Temperature Compensation Coefficient in mV per Deg C per Cell is entered in this screen. The allowable range
is 0.1 to 6mV/C/Cell. If the value is decremented below 0.1, the display will show Off.

This screen is available only when BTC is active. Set temperature level at which System Voltage is not corrected. Range 18°C to 27°C. Note Compensation range is 10-35°C

Please Note:

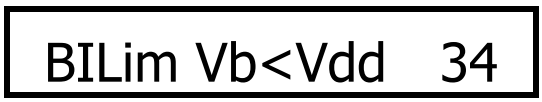
a) If there are no temperature sensors connected or if BTC is set to 0, the compensation function is disabled. In this instance, the status message in the MCSU home screen is FL or EQ instead of FLC or EQC.

b) If the Battery temperature sensor is not connected, compensation is then based on the ambient temperature sensor;

c) If both Ambient and Battery temperature sensors are connected, the compensation is based only on the battery sensor.

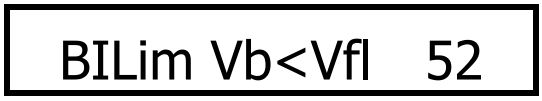
d) If temperature compensation is activated, the SMR voltage setting is automatically adjusted by the MCSU on a regular basis.

Battery Charging Current Limit applicable for voltages below Vdd. This parameter sets the maximum current which flows into the batteries when the voltage across the. two batteries is less than Vdd, the deep discharge voltage. Vdd is programmed in the next screen



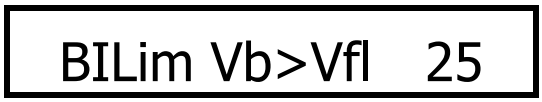
Battery deep discharge voltage -Vdd.

Battery Charging Current Limit when the battery voltage is between Vdd and the float voltage Vfl. This limit is normally higher than the one for a deeply discharged battery.



System Float Voltage; this sets the system output voltage at the output busbar terminals.

Battery Charging Current Limit for battery voltages greater than the float voltage. This applies when the batteries are being equalized.



Equalization Voltage. This sets the maximum voltage reached during equalization of the batteries.

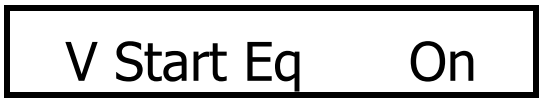
System Voltage Drop. This parameter is used to set the maximum voltage that the individual rectifiers can output over and above the programmed System Float voltage.

The System Voltage Drop parameter is calculated by summing the resistive voltage drop in each rectifier due to output connector, output relay and passive current sharing output "slope" and the expected drop of the busbars of the system. A typical value is 0.6V. For digital control, set the value for the drop to that expected at nominal load.

Battery discharging alarm level. This level is set to a value to which the battery voltage falls to during a discharge. It is used to issue an alarm indicating that the batteries are discharging.

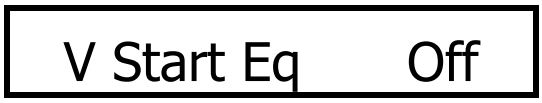
Enable/disable equalization charging.

Equalization initialized by voltage level V reached during battery discharge.

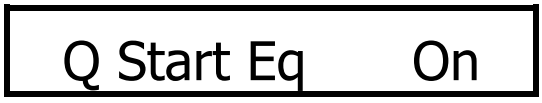


Equalization is initialized when the battery voltage falls to this level.

Equalization **not** initialized by voltage level.



Equalization is initialized based on charge supplied to the load by the batteries (measured in Ampere-Hours).



Equalization is initialized when the charge out of the batteries is greater than the level set in this screen.

Equalization is **not** initialized by the discharge A/H method.

Equalization is ended based on the level of battery charging current set in this screen.

If Equalization is to end independently of charging current, reduce the value of current in this screen to less than 5% of the A/H rating of the batteries (programmed in earlier screen) and the number will then be replaced by OFF as shown.

Equalization can be terminated after the time set in this screen. If termination is based only on the A/H discharge method, set this number to its highest value (48 Hr).

If no equalization occurs due to battery discharges for a period longer than the time set in this screen, an equalization
cycle will be initiated automatically.

Equalization can be ended manually by pressing ENTER when this screen appears. This screen is only obtained if the
system is in Equalization mode.

When ENTER is pressed, the system reverts to Float mode and the window changes to that shown, ready for a manual equalization start. This screen is only obtained if the system is in Float mode.

A Low Voltage Disconnect Switch (LVDS) is often integrated into the system to disconnect the batteries from the load in the event that the AC power outage is too long causing the batteries to discharge beyond a safe level. The voltage level at which the LVDS opens is set in this screen.

When this screen is as shown, the LVDS switch opens automatically when the voltage drops to the trip level set in

the previous screen. When the AC power is restored and the system output voltage rises after the rectifiers start up, the LVDS switch will close automatically.

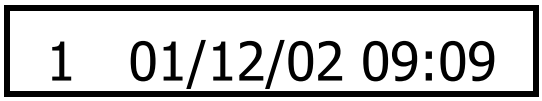
To operate the switch manually, press ENTER and the Auto will flash on and off. Press INC to scroll to Closed, followed by
Open followed by Auto again.
Press ENTER at the desired state - e.g. Open to open the switch.

5.8. Alarms Log Screens

A record of the most recent alarms is kept in the MCSU memory and can be viewed by momentarily pressing the Alarms Log pushbutton.

Alarm Log Pushbutton pressed - the screen shows the number corresponding to where the particular alarm is in relation to the most recent alarm which is number one, followed by the alarm name as shown in the example below: If the INC button is pressed within two seconds, the second alarm will be shown. If pressed again the third alarm appears etc.

If the button is not pressed for two seconds a date/time screen will appear which shows the alarm sequence number followed by the date and time at which the alarm occurred.



To clear the alarms log, press ENTER whilst in the Alarms Log menu and the following screen will appear:

Press the DEC button as requested and the log will be cleared and the following screen will confirm it.

5.9. Earth Leakage Detector

Note:**MUIB3 and MUIB5 only**. This function is only available on 110V and 220V versions of MCSU software and with special software for 24V and 48V systems. The parameters appear after the **Batt Rated xxAH** item in the **Batt**ery Menu screens.

The MUIB3/5 interface boards have a circuit that is designed to monitor any imbalance in the positive and negative DC bus voltage with respect to earth. With no external leakage current paths from the floating system the positive and negative voltage rails should be at equal potential about earth. When an external leakage current is present, the value of the current is displayed by the MCSU. As well, an alarm level can be programmed as shown below.

Earth leakage current: display shows the leakage current to earth in mA;

Earth leakage current alarm threshold: this can be set in the range 1.0 to 9.5 mA.

5.10. Battery Cell Monitor Setup

Note: This function is only available on special versions of MCSU software and appears as the first option in the Expan2 sub-menu.

For 110V and 220V systems, refer to the BCM2/BM3 sections for an appropriate configuration table.

5.10.1. Relationship between "BCM Batteries" and "Num Batteries"

With the BCM option enabled, the BCM parameters must be setup before monitoring can be performed. The screen indicating "BCM Batteries" is where you define the number of batteries whose cell voltages are to be monitored by the MCSU. There is no need to program the MCSU how many BCM boards are connected. The MCSU automatically calculates the number of BCM boards that it requires from the number of "BCM Batteries" that you entered. The number of BCM boards (PCBs) required for different battery configuration is shown in the following table (48V top, 24V bottom):

Batt Config	BCM Batt = 1	BCM Batt = 2	BCM Batt = 3	BCM Batt = 4
24 cell, 2V	1 BCM board	2 BCM boards	3 BCM boards	4 BCM boards
12 cell, 4V	1 BCM board	1 BCM board	2 BCM boards	2 BCM boards
8 cell, 6V	1 BCM board	1 BCM board	2 BCM boards	2 BCM boards
4 cell, 12V	1 BCM board	1 BCM board	1 BCM board	1 BCM board
12 cell, 2V	1 BCM board	2 BCM boards	3 BCM boards	4 BCM boards
6 cell, 4V	1 BCM board	1 BCM board	2 BCM boards	2 BCM boards
4 cell, 6V	1 BCM board	1 BCM board	2 BCM boards	2 BCM boards
2 cell, 12V	1 BCM board	1 BCM board	1 BCM board	1 BCM board

A similar menu but for totally different purposes, appears in the Systems menu as follows:

Num Batteries X (where X is the number of batteries)

The number of batteries entered here is the number of batteries that are being monitored for their currents. "Num Batteries" and "BCM Batteries" are not related except that value entered for "Num Batteries" must be greater or equal to "BCM Batteries". This is because Num Batteries determines the number of batteries accessible via the BAT menu, via which we access the cell voltages. So if only two batteries are defined for Num Batteries, then access to cell voltages of Battery 3 or 4, even if they are defined as 4 in the BCM Batteries menu, will not be possible. Normally Num Batteries is set to be the same as BCM Batteries.

5.10.2. Frequency of measurement

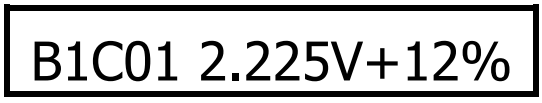
To allow for a wide battery capacity range which can range from 10 minutes to 8 hours, the cell voltage polling frequency is programmable in 1 minute increments. A typical polling interval is 4 minutes which would yield 15 points for a 1 hour discharge. For programmed test discharge of 30 minutes a polling interval of 2 minutes might be used. This parameter is not accessible from the MCSU front panel It is only programmable from a PC running WinCSU.

5.10.3. Battery Cell Measurements

When BCM is active, the individual cell voltages can be monitors on the MCSU by selecting a Battery from the **Batt** Menu and pressing ENTER. The cell information will appear on the screen and the next and previous cells can be selected by pressing the INC or DEC buttons. See below:

Battery 1 Current screen appears after pressing **BATT**. Pressing ENTER brings up the next screen.

Battery cell parameter: Battery 1, Cell "01", cell voltage "2.225V" which is deviating +12% from the average cell voltage of the battery string.



Battery 1, Cell "mm", Cell voltage "n.nnnV" which is deviating ±pp% from the average cell voltage of the battery string.
INC and DEC to change cell number.

5.11. Battery Discharge Test

Note: This function is only available on special versions of MCSU software and appears as the last item in the Battery Menu screens.

The Battery Discharge Test is a software function in the MCSU, which performs a periodic, controlled battery discharge using the load to discharge the battery. The test can be used to confirm capacity of the battery in the same way as a manual discharge using an external load would, except the normal system load is used without disconnection.

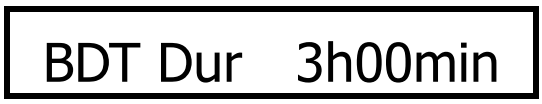
While Battery Discharge Test is active, the display will alternate between the "Home Screen" and the message "BDT in PROGRESS". The system alarms Battery Discharge, Voltage Low, SMR Voltage Low and Low Load will be suppressed, however SMR alarms will be shown in the SMR status.

To access the Battery Discharge Test parameters, enter the Batt menu and press DEC to get to the following screens:

Time interval (in days) between consecutive tests. Setting range 0 - 365. When set to zero, the automatic execution of the test is disabled (the display shows "Off"). The test can be activated manually from a PC running WinCSU (from CSU menu). Display messages from 2 to 6 will be shown only if the test is enabled.

Time of the day at which the test should start. Programmed in hours and minutes (24 hours format).

Time span during which the battery will be discharged. Programmed in hours and minutes (between 5 minutes and 24 hours), step of adjustment 5 minutes.

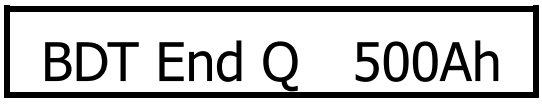


Current of battery discharge, controlled by MCSU. Programmable range 0A - 5000A. To ensure proper operation of this function, the load supplied by the system during the test must be greater by at least 10% than desired battery discharge current. MCSU will use the rectifiers to support surplus load, leaving the battery to supply a user defined amount of current to the load. If this parameter is set to zero, the control function is disabled and the battery will discharge under full load current.

End voltage of the test. Battery voltage, below which the test will terminate if reached before desired duration time expired. MCSU will restore normal operating parameters and start recharging the battery. The test result will be "Fail". Programmable range depends on the system voltage:

24V system: 18V to 24V,
48V system: 36V to 48V,
110V system: 75V to 120V.

End capacity of the battery. Principle of operation the same as described in par. 4. Programmable between 25Ah and 9995Ah



Reset of failed test alarm. This message will be seen only if last test failed and has not been reset. Pressing 'ENT' while viewing this display will reset the alarm and hide the message. The alarm can be also reset from a PC using WinCSU software.

Manual termination of the test. This message is displayed only when the test is running. Pressing 'ENT' on MCSU Front Panel while viewing this display will terminate test.

5.11.1. Results of last Battery Discharge Test

The remaining screen of the Battery Discharge Test gives details of the results of the last discharge test. The explanation of the codes are as follows:

Not Available. No test has been performed yet.

The test lasted for desired duration without reaching "End V" or "End Q" levels

Test terminated prematurely reaching "End V" or "End Q" level before duration time expired. This will trigger "BDT Fail"
MCSU level alarm.

A cell in a battery string discharged below safe level - alarmed, available only when BCM fitted and activated. Test failed.

Aborted due to loss of control of rectifiers, not alarmed.

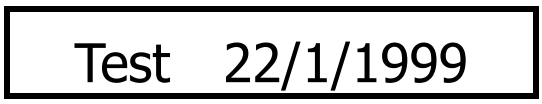
Aborted due to load being too low to control discharge current, not alarmed.

Aborted due to load being too high to support controlled discharge. Flagged if all SMRs indicate current limit. Possible only if rectifiers failed during the test. Not alarmed.

Terminated manually using MCSU Front Panel or from WinCSU

If during viewing this display the 'ENT" button is pressed, a sub-menu with details of the last test result will be accessed (if a test was performed). The results of the last test are stored in EEPROM. The entries are:

Date of the last test.



Duration of the test

Voltage of the battery at the time of termination of the test.

Remaining estimated capacity of a battery string at the time of termination of the test, where n is a number of the string.

The test is disabled for 100 hours if any of the following took place:

a) Controller has been powered-up (assumes a new installation)

b) AC failure has been recorded

c) Electrolyte low level has been recorded (only if sensor fitted and appropriate version of software installed).

If an automatic test was scheduled during that period, it will be performed at the next opportunity at the BDT Time.

6. Maintenance

In this section some general routine maintenance procedures are described which should be carried out to ensure that the equipment performs to the high reliability standards that it has been designed to.

6.1. Warnings and precautions

Since the unit utilizes high voltages and large storage capacitors, it is imperative to take great care when working on the unit.

In particular, only qualified personnel should be allowed to service the units.

In addition, the following precaution should be observed:

WARNING !!

Do not remove the cover with power on! Allow two minutes to elapse after switch off before removing the cover to make sure high voltage capacitors are fully discharged.

6.2. SMR Maintenance

Since the SMRs are fully alarmed and operate in an active loop current sharing arrangement, there is no need for regular checks or adjustments of operating parameters. However, some regular checks can be an early warning of problems waiting to happen.

6.2.1. Current Sharing

Under normal conditions, the output current variation from the average rectifier current by every rectifier should be within ±2A or ±3%, whichever is less. It is possible however, for internal loop parameters to change to such an extent that a unit does not share to the extent that it should.

If the lack of sharing is extreme then either a CURRENT LIMIT or NO LOAD alarm will be active and the operator should then refer to the next Section.

If, however, the current sharing is not so extreme as to generate an alarm, a regular check of the current sharing among the rectifiers can lead to early detection of any units which may be developing a fault.

In general, if only one or two units are "drifting", the most probable explanation is a "drifting" component in the main secondary voltage control card of the SMRs involved. If, on the other hand, many of the SMRs are not sharing satisfactorily, then the most likely problem area is in the MCSU.

6.2.2. Integrity of Electrical Connections

It is good practice to check all accessible electrical connections at regular intervals to ensure that no "hot spots" develop over time due to loose connections. An infra-red "hot spot" detector is very useful for this function.

Alternatively, mechanical connections can be checked manually for tightness.

6.2.3. Fan Filter Cleaning

As the SMRs are fan cooled, the air filter at the front of the fans will require regular cleaning to ensure there is sufficient air flow to keep the units operating reliably.

If the air filter is overly clogged, the lack of air flow may lead to the heat-sink temperature rising to the point that the Th (high temperature) alarm is active.

To clean the air filter using compressed air or similar means. Replace media ensuring that it is centrally located on the protective wire grille and push retainer in place.

After a period of 5 to 10 years, depending on average ambient temperature and air cleanliness, the fan bearings will begin to cause a slowing of the fan until the Ff (fan fail) alarm is activated. In such an instance, the fan must be replaced from the magazine.

7. Fault Finding and Replacement Procedures

This section describes in some detail the possible causes for alarms that may occur from time to time and the procedures that should be followed to clear the alarms and more importantly, redress the problem or cause of the alarm.

It is assumed here that the most that a field maintenance person will do is change a complete module. It is normally impractical to attempt to repair a particular unit without test equipment which is normally only available in the manufacturer's service laboratory.

The recommendation is for spare complete units to be kept on site. This includes a complete SMR, a MCSU unit, and a MUIB sub-assembly. The fault finding procedures are presented below.

7.1. System Fault Finding Procedures

The following table outlines suggested procedures to be followed if it is assumed that no internal repairs of units will be attempted. It is assumed instead that only MCSU adjustments and unit replacement will be performed.

Alarm Condition	Possible Cause	Action Suggested
UNIT OFF	No AC power to SMR	Check AC supply to SMR; if necessary reset CB supplying SMR
	SMR faulty	Replace SMR
Equalize Mode	Automatic cycle in progress due to recent AC power failure	No action required
	Automatic Periodic Equalize cycle in progress	Check on MCSU if system is in AUTO or MAN mode -If in AUTO mode, display will show remaining Equalize time. Check log for previous cycle date. If cycle too early, replace MCSU
	Manual initiation of Equalize cycle	Check Operator log; in BATT menu, scroll to "Manual Stop EQ" screen and press ENTER to terminate cycle if necessary
SMR Urgent	All SMRs off due to AC power failure	If possible restore AC power
	One or more SMRs off due to faults;	Check Individual SMRs for obvious problem; replace SMRs if necessary
	All SMRs off due to incorrect Inhibit signal from MCSU	Replace MCSU
	One or more SMRs in Current Limit	Check Current Limit settings and adjust if necessary; or batteries being recharged
SMR Alarm	Any of the above or non critical problem with one or more SMRs	Check SMRs
	Any of the above or No Load alarm	If unit is not sharing correctly, replace SMR
	Any of the above or unit is in Equalize mode	Check Equalize/Float Mode and change if in incorrect state; change SMR if MCSU is not requesting Equalize mode
AC Fail	Total AC power failure or AC voltage not within operating limits	Check AC supply and confirm condition; If AC is OK replace SMR units if only two show alarm condition
	Communications link failure	Check 4-way communications cable between MCSU and all SMRs
Cct Breaker	Fuse or CB within PDU has blown or tripped	Check PDU (Power Distribution Unit)
	Wire or connector loose on MUIB	Check MUIB connections and tighten
Battery Switch	Any one of 2 battery switches is open	Close if appropriate
	Bad connection to MUIB	Repair connection
Amb Temp High	Ambient Temperature is too high	Reduce temperature
	Temperature sensor is faulty	Check and replace if necessary
	Connection to MUIB is faulty	Repair connection
Batt Temp High OR Temp Sensor N/A	One of the 2 battery sensors is reporting temperature higher than	Check battery temperatures and if necessary increase ventilation and cooling

Alarm Condition	Possible Cause	Action Suggested
	pre-set level	

Alarm Condition	Possible Cause	Action Suggested
Batt Temp High OR Temp Sensor N/A	Set point is too low	Check Batt Temp High threshold level and re-adjust if necessary
	Temperature Sensor in MCSU not attached or faulty	Plug in temperature sensor if required; Replace temperature sensor
	Faulty MUIB connection(s)	Replace MUIB
	Faulty MCSU card	Replace MCSU
Volts High	SMR fault	SMR Fault Chart
	Float level set too high on MCSU	Check and adjust if necessary
	MCSU fault	Replace MCSU
Volts Low	AC power has failed; system on battery power	Restore AC power if possible
	Alarm threshold level set too high	Check set point and adjust if necessary
	All SMRs are off due to MCSU Inhibit signal	Check reason for signal; if necessary replace MCSU
	Battery charging current limit LED on due to faulty battery current signal - this will depress float voltage	Check battery currents. If one of them shows figure higher than Batt Chg Curr Lim set point, check corresponding current transducer; check connections to transducer; check MUIB connections
	Battery Temperature Compensation too high due to faulty battery temperature monitoring	Check battery temperature readings in Batt menu; Check and if necessary replace faulty sensor; check connection to MUIB
	Battery Temperature Compensation too high due to faulty MUIB	Replace MUIB
SMR HVSD	Output voltage too high due to SMR fault	Replace faulty SMR
	HVSD threshold on SMRs set too low	Check and re-adjust threshold level
	MCSU fault	Replace MCSU
SMRs not sharing load current	Faulty MCSU voltage and current control loop IODEM signal (analog active current control)	Replace MCSU
	Communications link malfunctioning or faulty rectifier (digital current control)	Replace Comms cable and/or SMR
	Float or Equalize level on MCSU set too high/too low.	Check and re-adjust Float or Equalize level on MCSU
No Response	SMR not responding to MCSU	Check and if necessary replace comms cable at back of magazine faulty
	Faulty microprocessor card in SMR	Replace SMR
Power Limit	Unit not current sharing (if only one showing power limit)	Replace SMR
	Load current too high (if more than one unit showing alarm)	Reduce load
		Reduce battery charging current limit if it is too high
No Load	Load circuit breakers have tripped and there is no load	Reset circuit breakers
	If only one unit showing alarm, comms line to SMR faulty	Check and replace comms line
	Faulty SMR	Replace SMR
Current Limit	Batteries being recharged if more than one unit showing alarm	No action required
	If only one unit shows alarm, internal control loop faulty	Replace SMR
No Demand	Internal control loop faulty	Replace SMR
	System has no load	No Action Required

Alarm Condition	Possible Cause	Action Suggested
EEPROM Fail	Faulty EEPROM or microprocessor card	Replace SMR
DDC Controller	Fault in DC/DC converter	Replace SMR
H/S Temp High	SMR Heat sink temperature too high	Check air intake to SMR is not blocked
	Ambient temperature is too high	Try to reduce ambient temperature
	microprocessor card is faulty	Replace SMR
Temp Sensor Fail	Temperature sensor is faulty	Replace SMR
Fan Fail (Units fan cooled only)	Air flow inadequate due to dirty filter	Clean or replace filter
	Air intake/outlet blocked	Remove air blockage
	Fan faulty	Replace fan if connection is OK
Reference Fail	Reference voltage source in, or entire microprocessor card is faulty	Replace SMR
HVDC not OK	Faulty boost controller	Replace SMR
	Inrush limiting fuse or resistor O/C	Replace SMR
High Volts SD	Feedback voltage circuit faulty	Replace SMR
	Faulty microprocessor card	Replace SMR
LVDS Open	Battery discharged to the limit voltage level due to no AC power	Check AC voltage and reset if possible
	Battery voltage OK, and MCSU faulty	Replace MCSU
	Battery voltage OK, and MCSU faulty	Replace MCSU
	LVDS threshold level set too high	Reset level in BATT menu
Sys Volts High	Volts High level in MCSU set too low	Reset level to correct value
	Temperature compensation coefficient set too high	Set correct temperature compensation coefficient
	Faulty MUIB or MCSU	Replace MCSU
Sys Volts Low	Volts Low threshold in MCSU set too high	Reset level to correct value
	Temperature compensation coefficient set too high	Set correct temperature compensation coefficient
	Faulty MUIB or MCSU	Replace MCSU
Battery Disch	Output voltage low due to SMRs off	Check AC voltage and restore if possible;
	Float level set too low	Set float level to correct value
	Battery Disch level set too high	Set correct Battery Disch level
	Faulty control loop in MCSU	Replace MCSU
SMR Comms Fail	Comms cable faulty	Replace cable
	Faulty MUIB or MCSU	Replace MCSU
AC Volt Fault	AC voltage out of tolerance	Check AC voltages and fix if possible
	AC voltage threshold levels incorrect	Set correct levels
	Faulty AC monitoring unit MMIB1or2	Replace monitoring unit
	MUIB or MCSU faulty	Replace MCSU
AC Freq Fault	AC frequency out of tolerance	Check AC frequency and fix if possible
	AC frequency threshold levels incorrect	Set correct levels
	Faulty AC monitoring unit MMIB1 or 2	Replace monitoring unit
	MUIB or MCSU faulty	Replace MCSU
Batt I-Limit	Battery charging current is being limited to preset value	No action necessary
	Battery current limit set too low	Set correct limit
	Battery current sensor faulty	replace sensor
	Faulty MUIB or MCSU	Replace MCSU
Batt Sym Alarm	One Battery string is faulty	Repair/replace battery if necessary
	Battery discharge current differential level set too low	Set correct level of Disch I Diff in BATT menu
	Battery current sensor is faulty	Check and replace sensor if necessary
	Faulty MUIB or MCSU	Replace MCSU

Alarm Condition	Possible Cause	Action Suggested
Earth Leak Alarm	Excessive Earth current due to either failure of load supply isolation or faulty load equipment.	Locate source of earth leakage current and correct accordingly.

7.2. MCSU Fault Finding and Repair Procedures

In addition to performing a supervisory function by monitoring output voltage and current and the various system alarms, the MCSU also performs a voltage control function in order to achieve battery charging current control, battery temperature compensation, battery equalization and active current sharing.

To control current to the lowest battery voltage, the MCSU has the ability to suppress the SMR output voltage to a value lower than the minimum battery voltage.

It therefore follows that it is possible for a MCSU fault to occur which can suppress the SMR voltage to that low level and thus cause a battery discharge despite the precautions that have been taken to ensure that this does not happen.

In such a situation disconnecting the 4-way cable which connects the SMRs to the MCSU will remove the voltage suppressing PWM control signal and thus avoid the batteries discharging. Without the MCSU connected, the SMRs will revert to their pre-set Float voltage and passive current sharing.

The MCSU can then be changed to resolve the problem.

There are virtually no electronic components on the MUIB except for the Remote alarm relays, and some fuse links, but there are many connectors. It is worth checking for poor connections when a MCSU system problem is being investigated.

7.2.1. Replacing MCSU

To replace a MCSU the following procedure should be followed, Mini CSU connector Diagram Shown in **Figure 7.1**:

1. Remove the knurled screws holding the MCSU front panel to the rack and remove it;
2. Gently pull the MCSU unit forward, and hold it in a horizontal position until the back is just clear of the rack.
3. Unplug the 34-way cable first (removes all power) and then the other cables. The SMRs will now be working in passive current sharing mode and current sharing may not be as good as previously. The output voltage will also rise to the value pre-set in the SMRs. Please refer to the paragraph 7.2.2. as per steps for removing MCSU from the magazine.
4. Bring the replacement MCSU to its position in the rack and plug in all the cables **making sure that the 34-way cable is connected last**. Please refer to the paragraph 7.2.3. as per steps for inserting the MCSU into the magazine;
5. Gently push unit into rack and secure the MCSU front panel with screws supplied;
6. Check operating parameters.

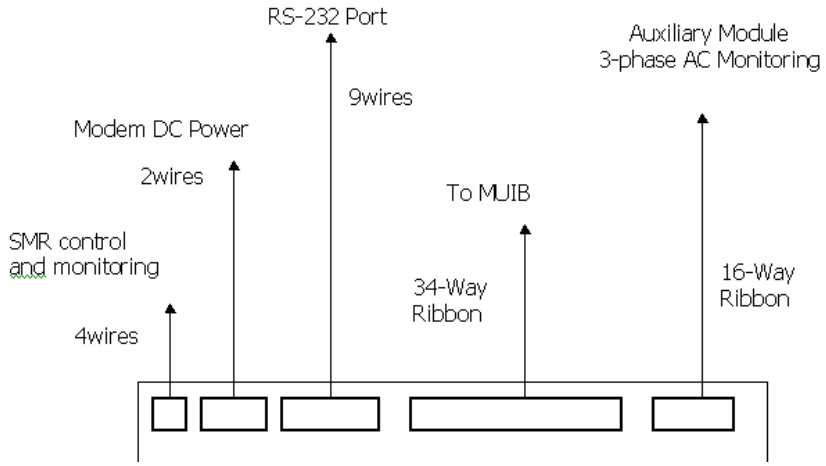


Figure 7.1 MCSU connector Diagram

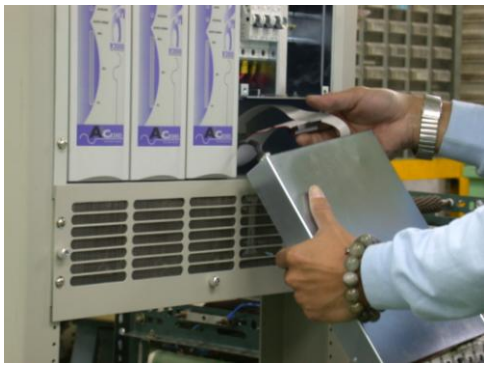
7.2.2. Removing the MCSU from the magazine

Step (1):

Remove the knurled screws holding the MCSU front panel to the rack and remove it.

Step (2):

Gently pull the MCSU unit forward, and hold it in a horizontal position until the back is just clear of the rack.



Step (3):

Unplugging the 34-way ribbon cable first.

Step (4):

Unplugging the 16-way ribbon cable.

Step (5):

Unplugging the 4 wires communication links.

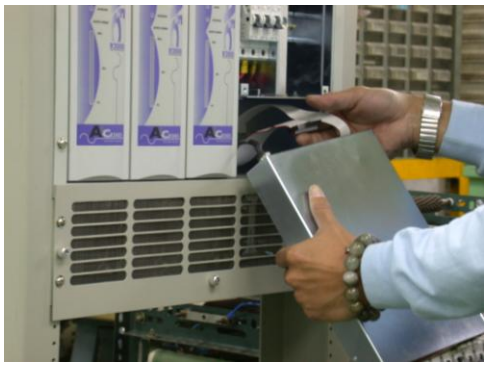
7.2.3. Inserting the MCSU into the magazine

Step (1):

Replugging the 4 wires communication links.

Step (2):

Replugging the 16-way ribbon cable.



Step (3):

Replugging the 34-way ribbon cable. To make sure the 34-way ribbon cable is connected last.

Step (4):

Arranging all wires & cables smoothly in right position before plugging it into the magazine.

Step (5):

Pushing the MCSU backward and holding it slowly in a horizontal position.

Step (6):

Pushing the MCSU completely to the end.

Step (7):

Remounting the MCSU front panel with screws supplied.

Step (8):

Replace MCSU is done and then check the operating parameters.

8. APPENDIX A - Summary of Programmed System Parameter

The table below lists the parameters programmed into MCSU for the installed system by sequential menu item.

Parameter	Description	Range	Nominal
Home (System) Menu			
Amb Tmp Alm	Ambient temperature alarm level	30-90°C	55°C
Volts Hi	System output volts high threshold	52-66V	57.0V
Volts Low	System Output volts low threshold	40-54V	49.0V
No. of SMRs	Set number of SMRs in the system	0-60	1
Num Batteries	Number of Battery strings installed	1 or 2	1
FS Batt I	Battery current transducer full scale rating	10-9990A	100A
CSU #	CSU Access code (up to 7 digits)	0-9999999	0000000
Date	Current system date		
Expan 1 Submenu			
AC 1-ph Menu	(After enabling AC 1-ph)		
1ph ACV Hi	AC supply high voltage alarm	220-315V	260V
1ph ACV Lo	AC supply low voltage alarm	140-270V	200V
1ph ACF Hi	Frequency high alarm	50-65Hz	55Hz
1ph ACF Lo	Frequency low alarm	40-60Hz	45Hz
1ph ACI FS	AC supply current transducer full scale rating	10-200A	100
Expan 2 Submenu			
AC 3-ph Menu	(After enabling AC 3-ph)		
3ph ACV Hi	AC supply high voltage alarm	220-315V	260V
3ph ACV Lo	AC supply low voltage alarm	140-270V	200V
3ph ACF Hi	Frequency high alarm	50-65Hz	55Hz
3ph ACF Lo	Frequency low alarm	40-60Hz	45Hz
3ph ACI FS	AC supply current transducer full scale rating	10-200A	100A
Batt Monitor Menu			
Batt Mon	Enable/disable BCM	On/Off	
Bat Conf	Battery Monoblock size x number (see BCM section of manual for more detail)	Various configurations	
BCM Batteries	Number of battery banks to be monitored	1-4	1
Vhi Cell	Cell high voltage alarm	2.0-16.0V	2.5V
Vlow Cell	Cell low voltage alarm	1.0-12.0V	1.8V
+dVc Cell	Cell positive deviation alarm	5-99%	20%
-dVc Cell	Cell negative deviation alarm	5-99%	20%
SMR Menu			
SMR V High	SMR voltage high alarm	52-65V	56.0V

Parameter	Description	Range	Nominal
SMR V Low	SMR voltage low alarm	44-54V	48.0V
SMR HVSD	SMR HVSD	54-66V	57.5V
SMR I Limit	SMR current limit	5-52A	52A
Battery Menu			
Disch I Diff	Battery string discharge current difference alarm	5-99A	20A
Batt T Alrm	Battery Temperature alarm threshold	30 to 90°C	40°C
Bat Rated	Ampere-hour rating of batteries	20 to 9999AH	500AH
E Leak Alm	Earth leakage current alarm threshold	1.0-9.5mA	5 mA
BTC	Battery Temperature Coefficient	0-6mV/°C/cell	0 mV
Number Cells	Number of chemical cells in battery string	22-42	24
BILim Vb<Vdd	Battery charging current limit for Vb < Vdd	5-999A	50A
Vdd Level	Battery deep discharge voltage threshold	40-47V	45.0V
BILim Vb<Vf1	Battery charging current limit between Vdd & Vfl	5-999A	50A
Sys Float	System float voltage (Vfl)	48-58V	54.0V
BILim Vb>Vf1	Battery charging current limit in equalize Vb > Vfl	5-999A	50A
Sys Equal	System equalize voltage (Veq)	50-61V	55.0V
Sys Drop	System voltage drop	0.0-1.0V	0.0V
B Dis Al	Battery discharge alarm threshold	44-52V	47.0V
V Start Eq	Enable/disable discharge voltage initiation of Eq	On/Off	
V Eq trig	Discharge voltage threshold for Eq. charging	44-50V	48.0V
Q Start Eq	Enable/disable battery charge depletion trigger	On/Off	
Qdis Trig	Charge depletion threshold for Eq. charging	5-999AH	15AH
EQ End	Equalization termination for Ibat < EQ End	0-2000A	5A
Equal Dur	Maximum duration of Equalization charging	3-48Hr	20Hr
Equal Per	Time between periodic Equalization charging	1-52Wk	12Wk
Manual Start/Stop	Force start/stop of Equalization charging	Toggle state	
LVDS Trip	Battery voltage below which will open LVDS	40-48V	44.0V
BDT Per	Period between consecutive discharge tests	0-365days	30 days
BDT Time	Time of day to begin BDT (hr:min)	00:00-23:59	02:00
BDT Dur	Maximum duration of BDT	5-1440min	180min
BDT Curr	Discharge test current	0-5000A	50A
BDT End V	Battery voltage limit to terminate BDT	36-48V	44.0V
BDT End Q	Battery capacity limit to terminate BDT	25-9995AH	300AH

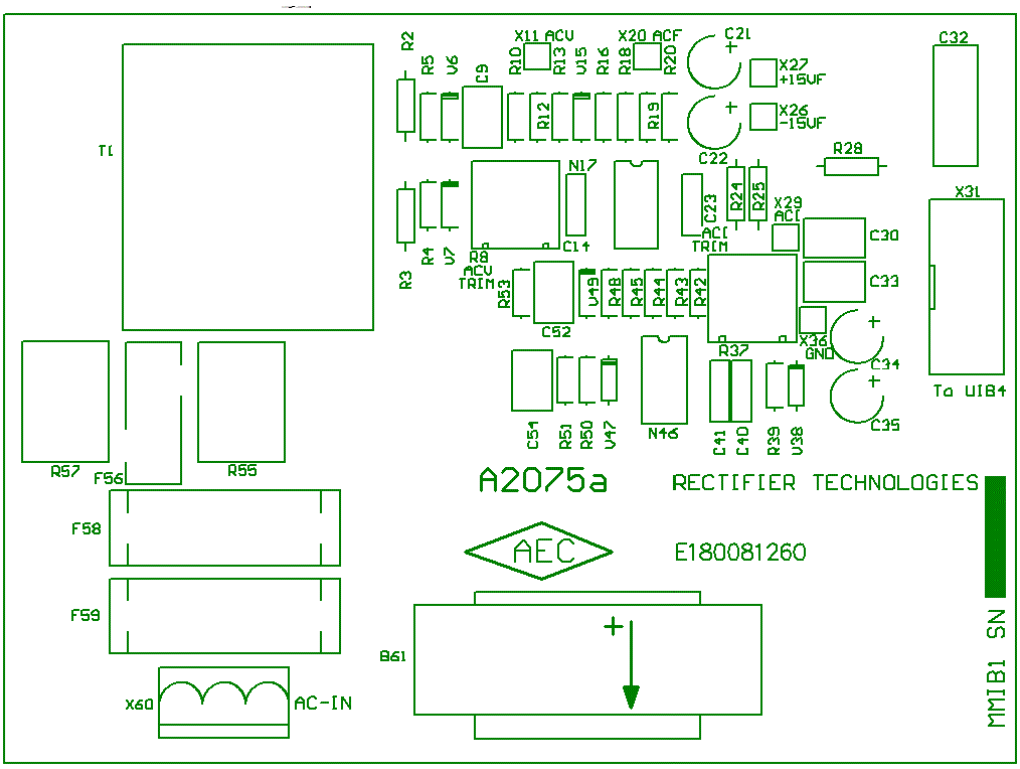
* Ver : MCSU2048 V01

9. APPENDIX B – Optional Interface Board

9.1. MMIB1 - Single Phase AC Monitoring Module

In low power systems where single phase power only is supplied, an optional single phase monitoring module (MMIB1) can be used to monitor the incoming AC voltage, current and frequency. The module is connected between the incoming supply and the AC Distribution module and connects to the MUIB and derivatives via a 10-way ribbon cable.

The block diagram of the MMIB1 module is shown below in **Figure 9.1**. (Note: MMIB1 cannot be used with MUIB3).



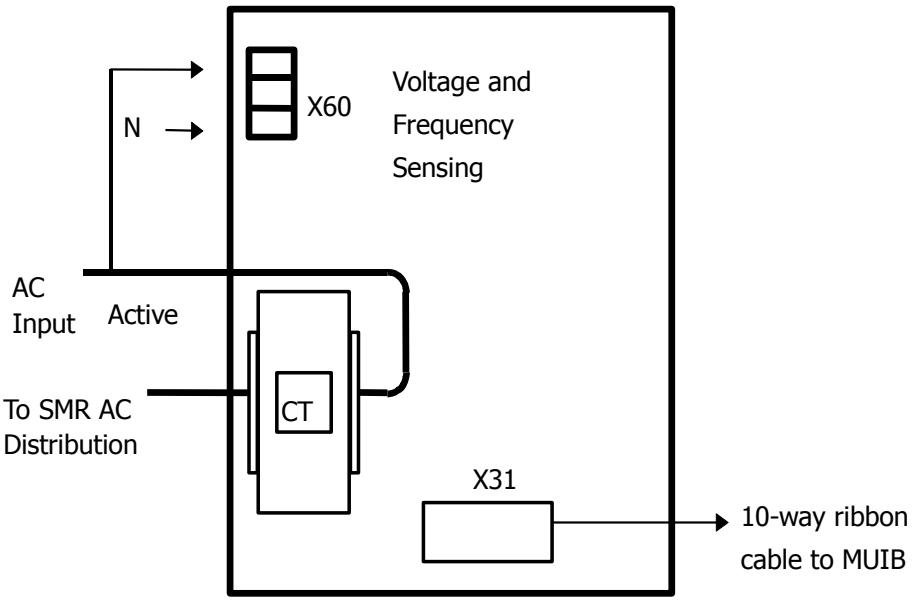
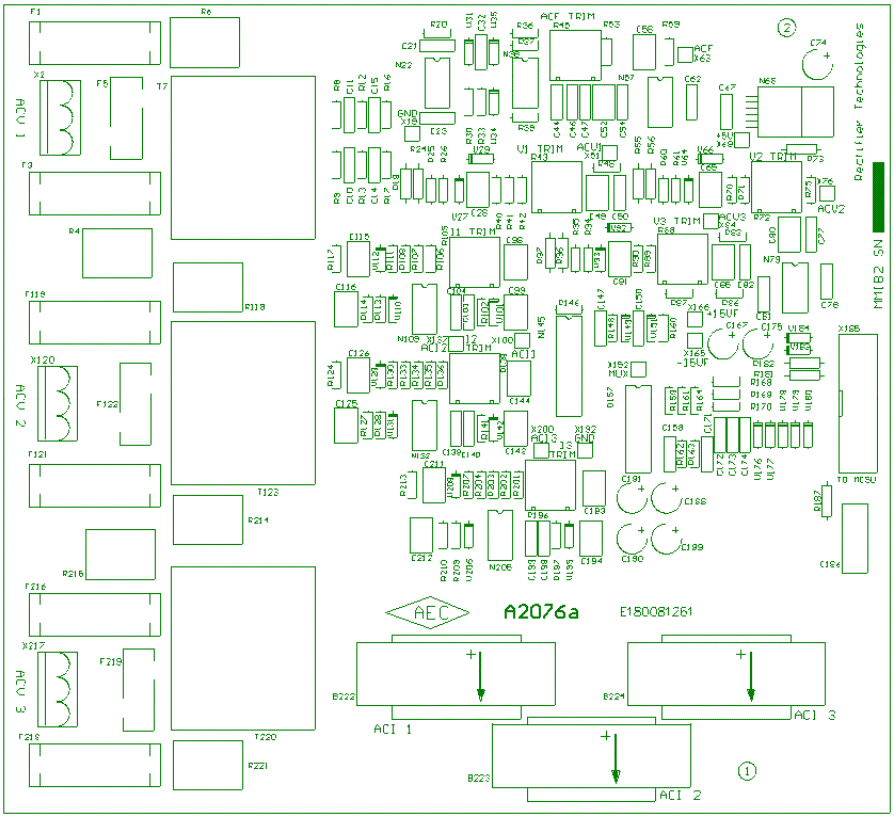


Figure 9.1 Single Phase AC monitoring unit MMIB1 block diagram

9.2. MMIB2 - Three Phase AC Monitoring Module

For large power systems where the rectifiers are balanced over all three phases, an optional three phase monitoring module (MMIB2) can be used to measure the AC supply phase-neutral voltages, phase currents and supply frequency. The MMIB2 connects directly to the auxiliary port at the rear of the MCSU or at the end of a daisy-chain of auxiliary port connections and does not use any connections on the MUIB.

The module is normally fitted inside the AC distribution module if one is used. A block diagram of the MMIB2 is shown in **Figure 9.2** below.



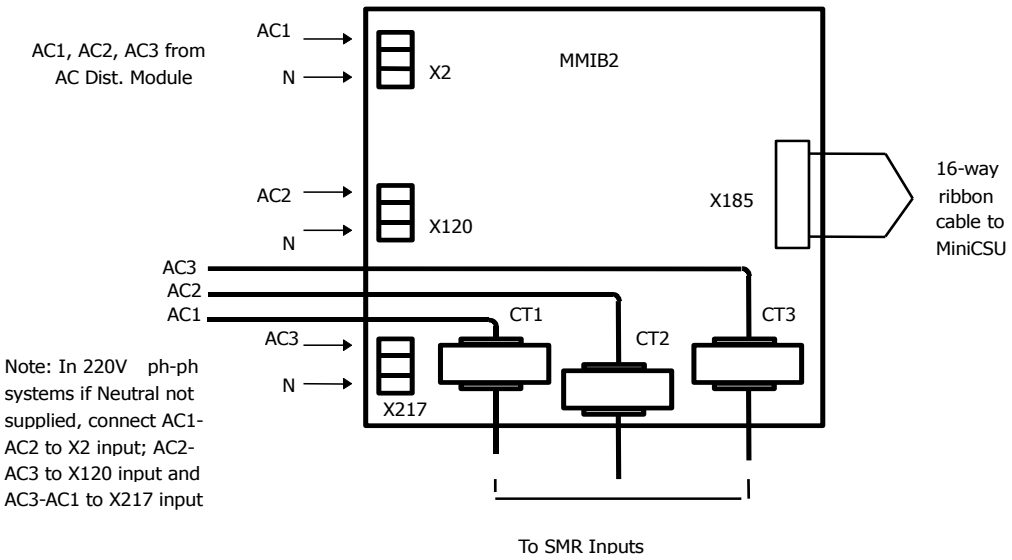


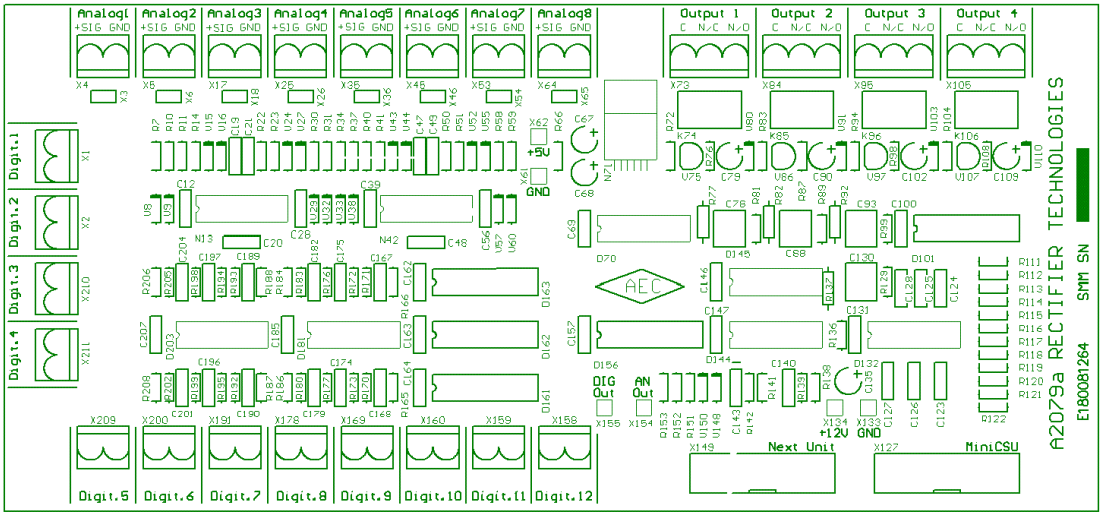
Figure 9.2 Three Phase AC monitoring unit MMIB2 block diagram Commissioning

9.3. SMM - Site Monitor Module

Site Monitor Module is an expansion of the MCSU, which allows the user to monitor status of equipment which is not a part of an AEC power system. It may also be used to monitor other (third party) DC power systems. Its usefulness can be specially appreciated in remote, unmanned installations. Using the same communication link and WinCSU monitoring software it is possible to supervise a number of such sites from a central monitoring station.

Four control outputs are provided in the form of voltage free change-over relay contacts. The relays can be automatically activated in response to an event on any of the module inputs (assigned by user), or operated manually from a PC.

Note: If the Site Monitor is to be added to an existing installation with AEC Power System, change of MCSU software may be required. WinCSU software will also may need an upgrade.



9.3.1. Electrical Specification

Number of Analogue Inputs	8
Analog Signal Input Range	0V to +5V,
Analog Signal Protection	Over-voltage and reverse polarity protected. Note: each analogue input must be floating
Analog Signal Scaling and Alarm Levels	Scaling factor, Low and High alarm levels are user programmable from WinCSU only.
Number of Digital Inputs	12
Type of Digital Signal Source	Voltage free contacts
Logic of Digital Input	User defined from WinCSU only
Number of control outputs	4
Output type	Voltage free change over relay contacts, 1A@30VDC
Power Source	MCSU (powered indirectly from system DC bus)

9.3.2. Physical Specification

Board Dimensions	Approx. 210mm x 96mm
SMM - MCSU Connection	16 Way Ribbon Cable
Signal Input Connectors	2 pin male header 5.0mm pitch. Mfr: Weco, P/N: 120-M-221/02.

	Matching female plug P/N: 120-A-111/02 provides screwed connection for wire up to 1.5 mm^2
Output Connectors	3 pin male header 5.0mm pitch. Mfr: Weco, P/N: 120-M-221/03.
	Matching female plug P/N: 120-A-111/03 provides screwed connection for wire up to 1.5 mm^2

9.3.3. Installation

Wiring of the site monitor is entirely dependent on the signals to be monitored. **Figure 9.3** show the basic wiring diagram of a system using a site monitor and a Battery Cell Monitor. Signals such as site security (windows and doors being opened) are usually connected as digital inputs, while fuel levels, inverter voltage/current/frequency are measured using the analog inputs.

9.3.4. System Set-up

The set up of the site monitor including labels of inputs, scale factors, alarm levels, designation of relays to operate and the type of digital input source (normally open or normally closed) can only be done using a PC running WinCSU. See WinCSU operation manual for details.

Once programmed, monitoring of the levels and minor modification of levels and scaling on site can be done from the front panel of the MCSU (see Operation section of this manual), but primarily, the site monitor is designed to be used from WinCSU.

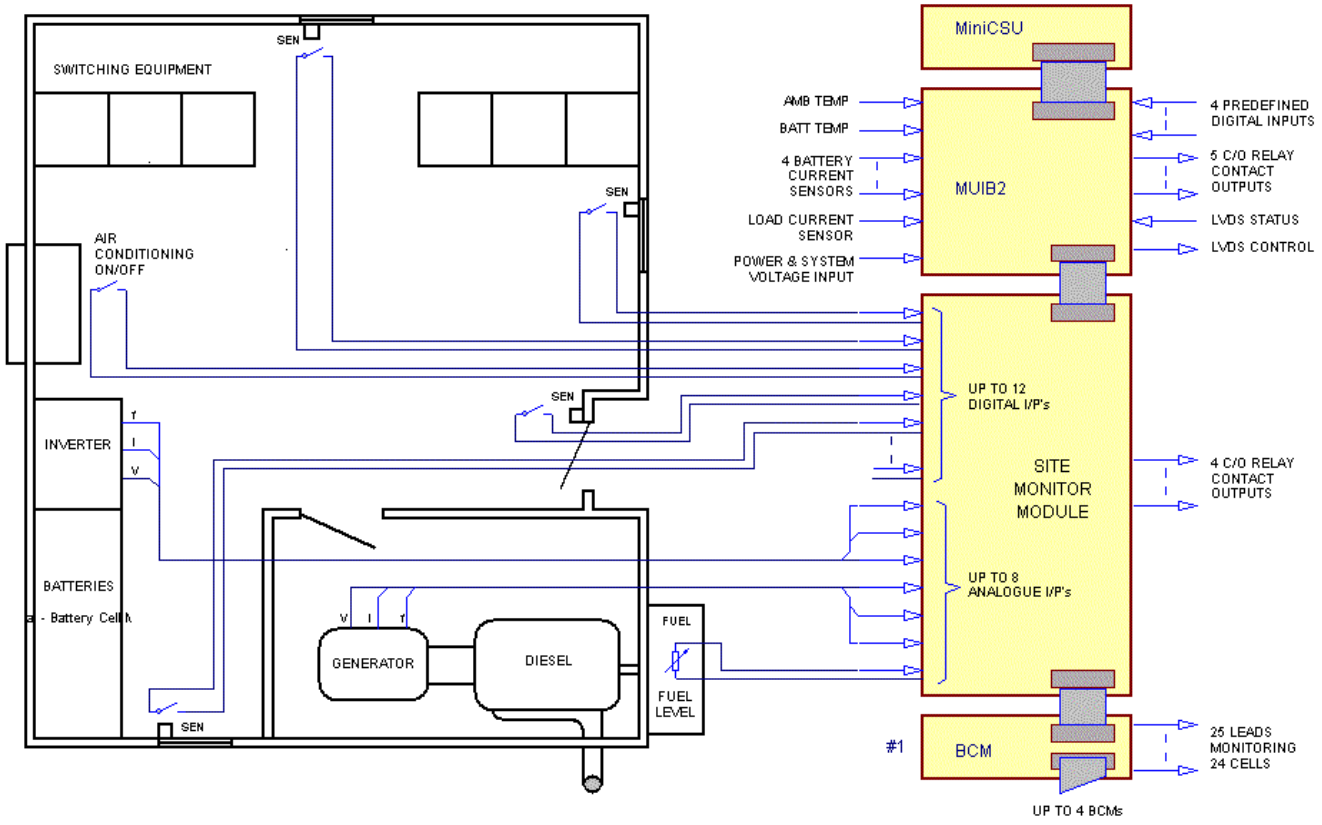


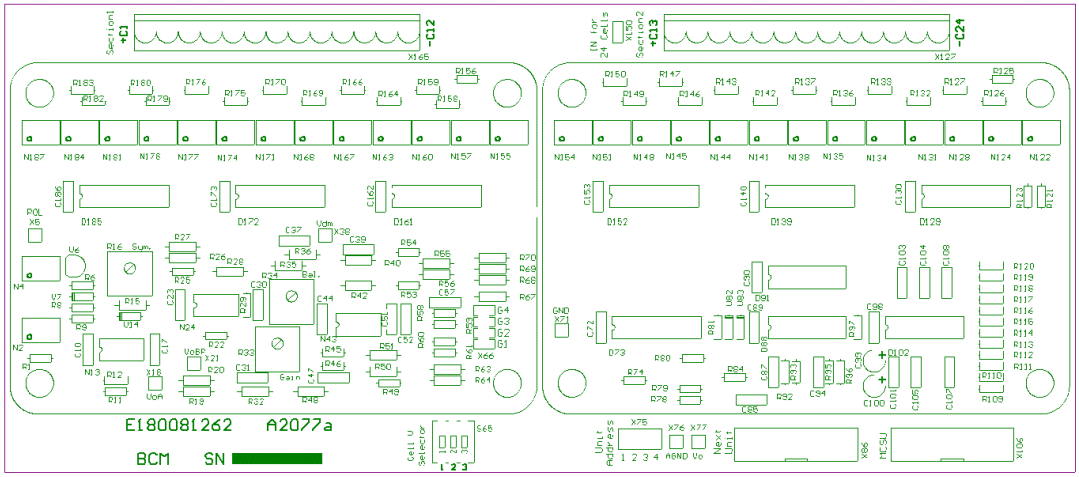
Figure 9.3 Example Site Monitor Wiring Diagram

9.4. BCM - Battery Cell Monitor

The Battery Cell Monitor (BCM) is an add-on module for the MCSU. It is used to monitor individual cells of a battery during float or equalization operation, or during a discharge. Each BCM unit is capable of monitoring up to 24 cells. A total of four BCM units can be used to monitor 4 battery strings of 24 cells each.

Using the ability of the MCSU to communicate to a remote or local PC, cell voltage data accumulated during a discharged can be transferred to a PC and saved. The cell voltages can also be viewed in real time when the MCSU is connected to a PC. The WinCSU software that is running on the PC can display the cell voltage data in various convenient formats to ascertain the state of health of batteries.

In the event that the battery behaves in a way which is less than ideal during a test or actual discharge, a number of pre-programmed parameter levels are used to generate alarms which are annunciated on the MCSU front panel by a LED and screen message and remotely via voltage free relay or via the RS-232 communications port which can connect directly to a PC locally or remotely via a modem.



9.4.1. Main Features of the BCM

The principle features of the BCM are as follows:

- Up to 24 cells can be monitored by a single BCM module. Cell voltage setting can be 2V, 4V, 6V and 12V.
- Up to four BCM board can be connected to a single MCSU.
- Individual cell voltages of a battery can be viewed on the MCSU display in real time. The cell voltage rounded to the nearest 5mV (applies only to 2V range) is displayed together with the cell number and its percentage deviation from the average cell voltage of the battery.
- All the cell voltages can be displayed in a "Histogram" format on a local or remote PC using WinCSU software.
- The PC can display the real time cell voltages or cell voltages stored during a previous discharge.
- A line graph of cell voltage versus time can be selected as the PC display to observe the manner in which the cell voltages as a whole decreased during a discharge. It is also possible to select for all the cell voltages to be displayed (in different colors) or for a particular cell voltage to be displayed together with the average cell voltage as a function of time.
- As the BCM is permanently connected to the batteries, an automatic, daily or weekly down-loading of the steady state cell voltages for the different batteries in a system ban be made to a remote monitoring PC.
- A discharge can be initiated either locally or remotely by triggering the rectifiers in the system into "battery discharge test" mode. In the mode the rectifier float voltage is set to a lower value which ensures that the batteries are carrying the load, but not too low so that in the event of battery failure during the test, the rectifiers will prevent the voltage from falling below the set voltage, which enable the load to continue functioning correctly. This test can be arranged to occur in non critical times and is used

to monitor the condition of the battery strings.

9.4.2. BCM Specifications

Battery configuration options:	(48V systems):	(24V systems):
	24Cell x 2V, 12Cell x 4V, 8Cell x 6V, 4Cell x 12V	12Cell x 2V, 6Cell x 4V, 4Cell x 6V, 2Cells x 12V
Maximum battery voltage:	75Vdc	
Number of cells:	24 maximum per board	
Cell Voltage selection	2V (max input: 3.33V)	
(DIP switch setting on the board):	4V (max input: 6.66V)	
	6V (max input: 10V)	
	12V (max input: 20V)	
	Note: "Cell" can mean both single battery cell or monoblock.	
Accuracy for 1 year:	± 10mV at 0°C to 40°C	
Resolution:	5mV per cell (2V, 4V, 6V range), 10mV per cell (12V range)	
Sampling interval range for discharge log:	1 - 60 minutes	
Power supply: from MCSU	±15V	
Maximum distance from MCSU:	10m (of 16 way ribbon cable)	

9.4.3. Preparing the battery for connection to the BCM

Battery cells are not connected to the BCM directly. 56Ω/PR02 resistors are inserted between BCM and the cells to clear any fault that would arise if a battery cell lead were shorted. The resistors are mounted as near as possible to the battery terminal in order to protect as much of the wiring as possible. A typical connection is shown **Figure 9.4**.

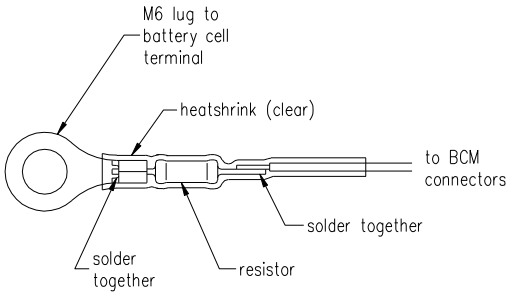


Figure 9.4 Lead termination at battery cell.

The M6 ring lug (depending on type of battery) is screwed onto the cell terminals. The other end of the wire is screwed onto the 5.0mm pitch screw terminals. Details on how the cells connect to the BCM board are discussed in later sections.

9.4.4. Installing the board

Generally, the BCM board is located close to the batteries so that it is not necessary to run large number of wires for long distances. The 16 way ribbon cable connecting to the MCSU can be up to 10m long, but should be connected directly to the MCSU, instead of connected at the end of another chain of peripherals. This helps reduce errors. This connection can be achieved by using a 'daisy chain' ribbon where the one cable has connectors placed

part way along its length as well as the ends.

Mount the BCM using the standoffs supplied in an area protected from mechanical and electrical hazards. If the rack does not provide any holes or studs for mounting the BCM, use **Figure 9.5** BCM mounting hole locations. as a template for drilling the mounting holes. Be sure to allow at least 25mm space around the board to allow for wiring to the board.

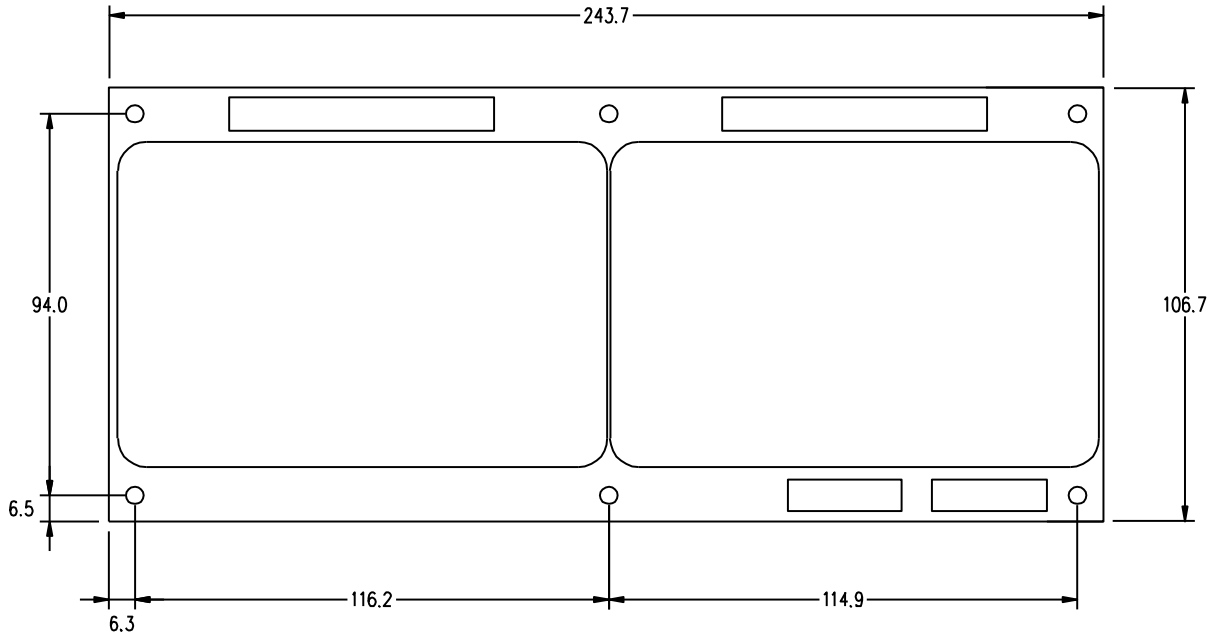


Figure 9.5 BCM mounting hole locations.

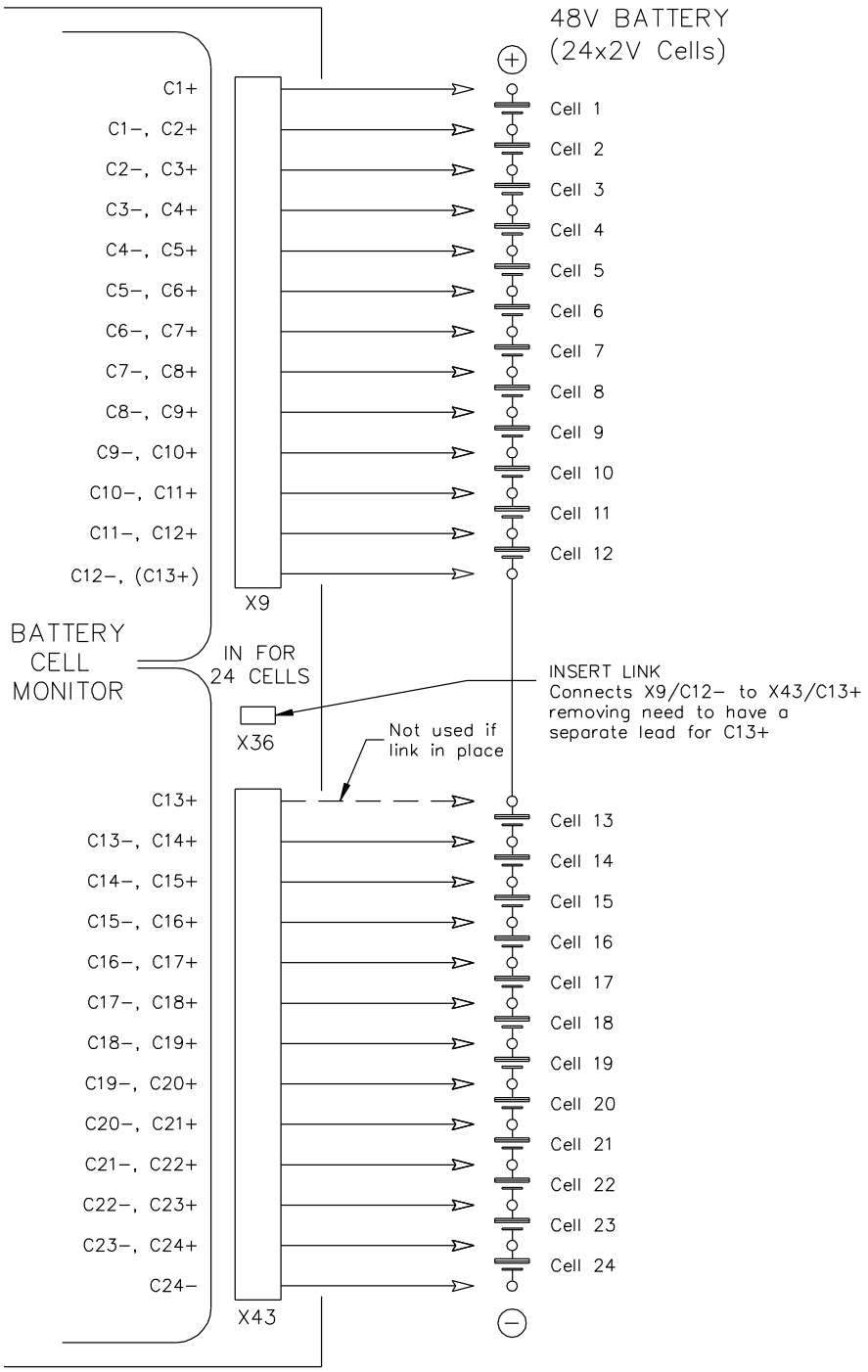
9.4.5. Dip-Switch Selection of Cell Voltages

Battery configuration is selected via the main menu of the MCSU, whereas the cell or monoblock voltage must be selected via dip-switch S65 on the PCB. The following table indicates the DIP-switch setting for different cell/monoblock voltages:

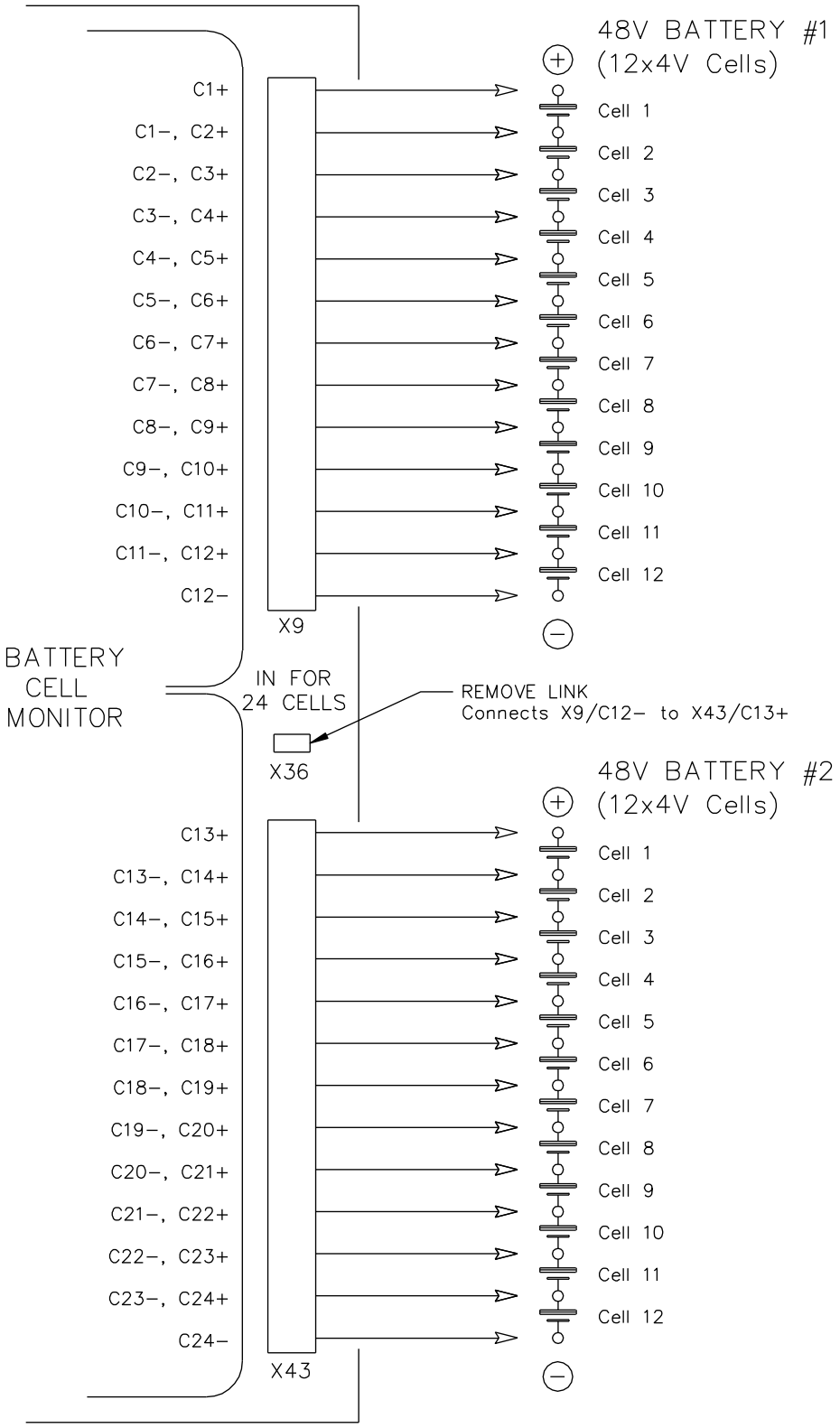
CELL/MONOBLOCK VOLTAGE	LEFT SWITCH (1)	CENTRE SWITCH (2)	RIGHT SWITCH (3)
12V	UP	DOWN	DOWN
6V	DOWN	UP	DOWN
4V	DOWN	DOWN	UP
2V	DOWN	DOWN	DOWN

9.4.6. Battery Cell Lead Connection to the BCM board

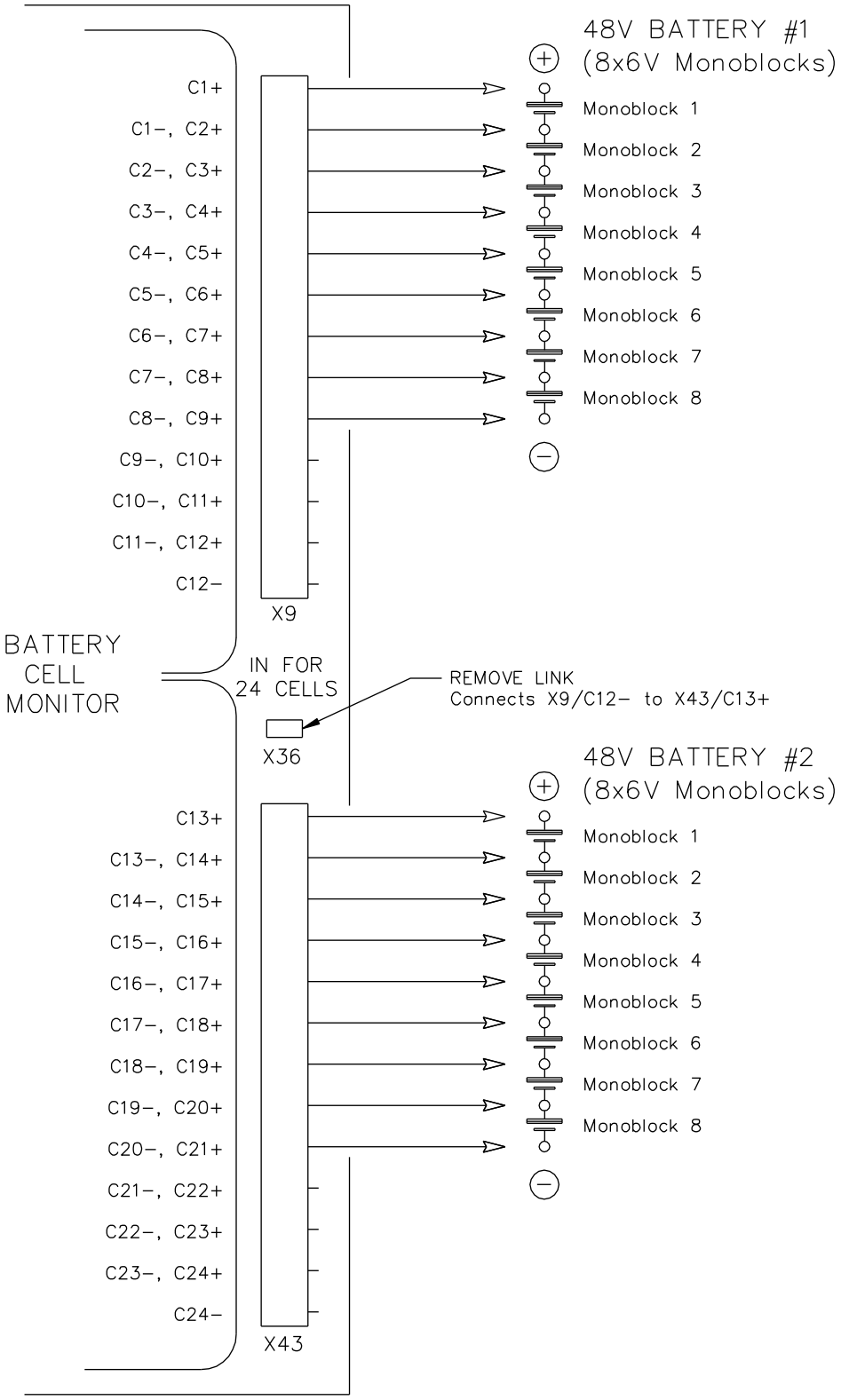
The battery cell voltage sensing leads are terminated with 13 way female (Weco 5.0mm pitch) screw terminals. This plugs onto the connectors on the BCM board. How the cell voltage sense leads connect to the BCM board depends on the battery configuration. The following **Figures 9.6~9.13** show the connection between the battery to the BCM board for different configurations of the battery. If more than 2 batteries are used a particular configuration, simply repeat the connection method for batteries 3 and 4.



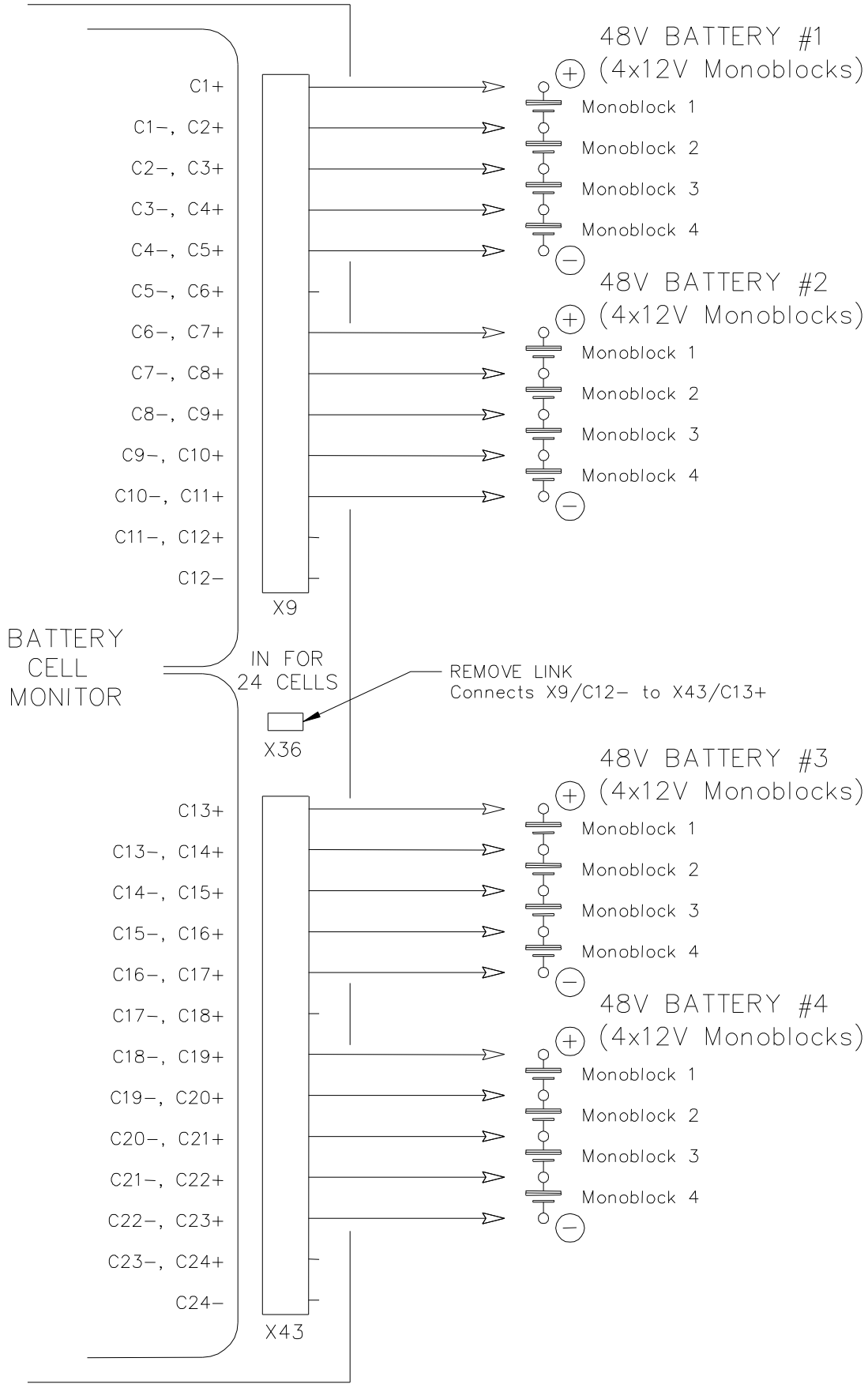
Figures 9.6 BCM connections to a 48V (24 cell) battery bank.



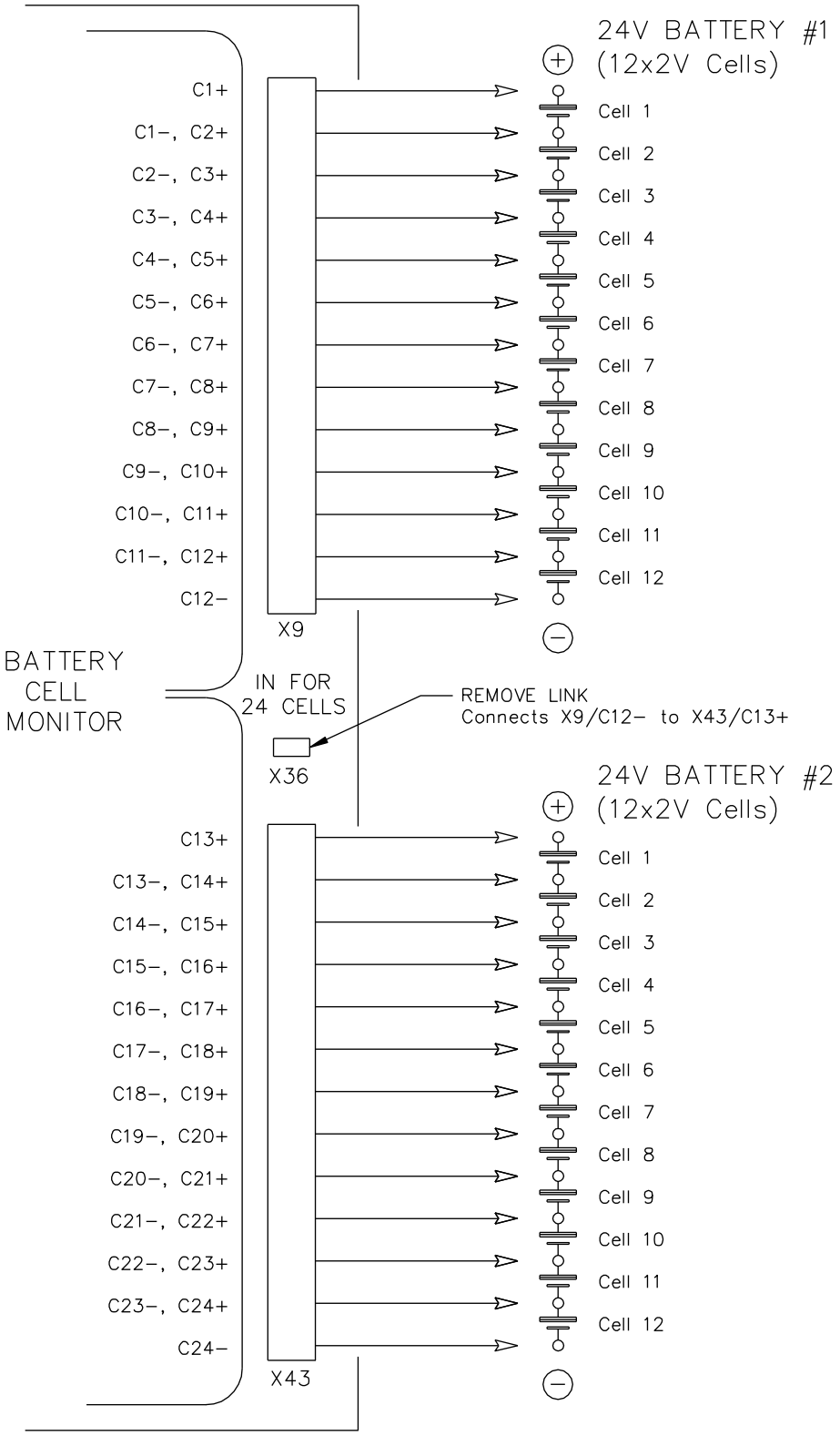
Figures 9.7 BCM connections to two 48V (12 cell) battery banks.



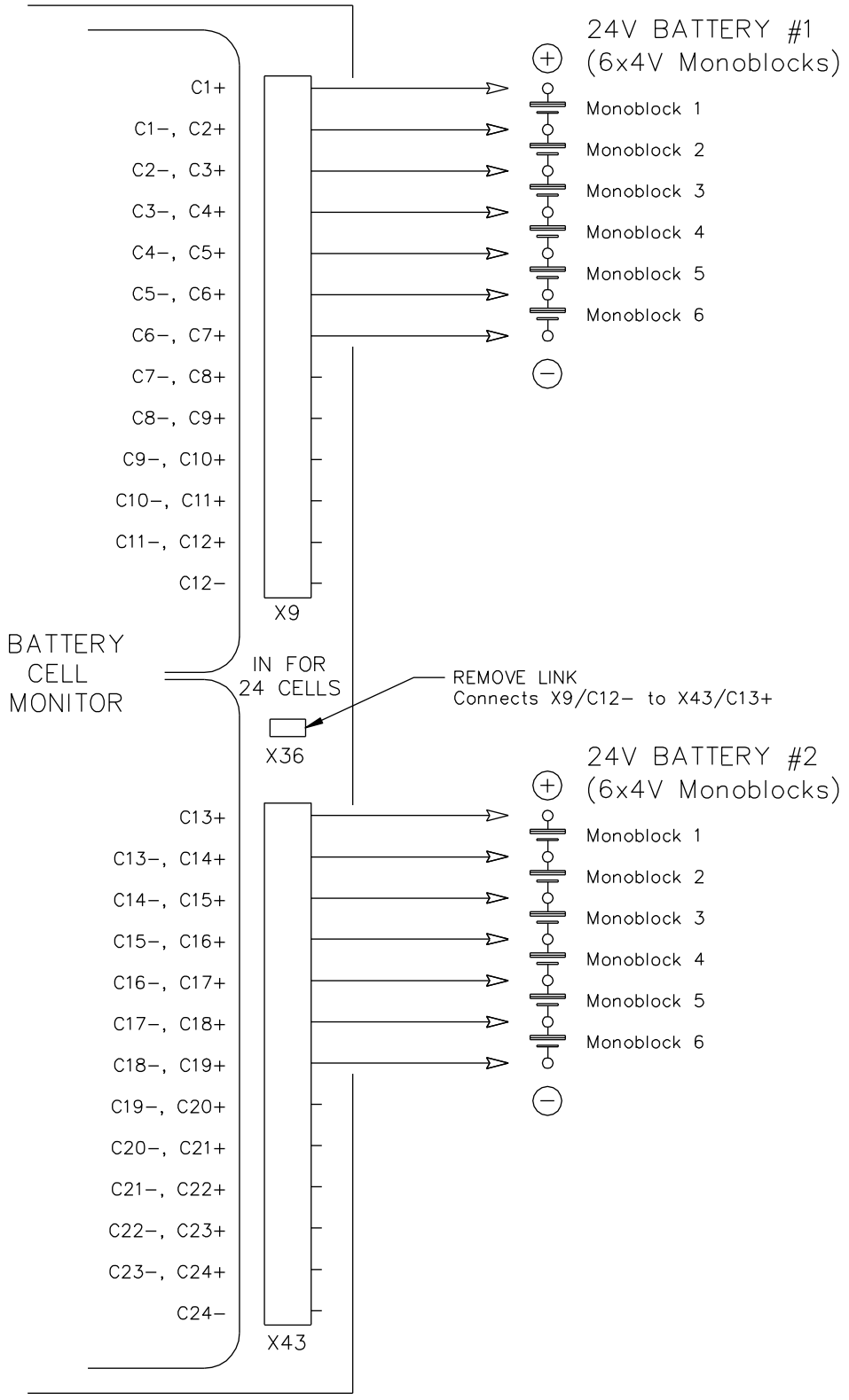
Figures 9.8 BCM connections to two 48V (8 monoblock) battery banks.



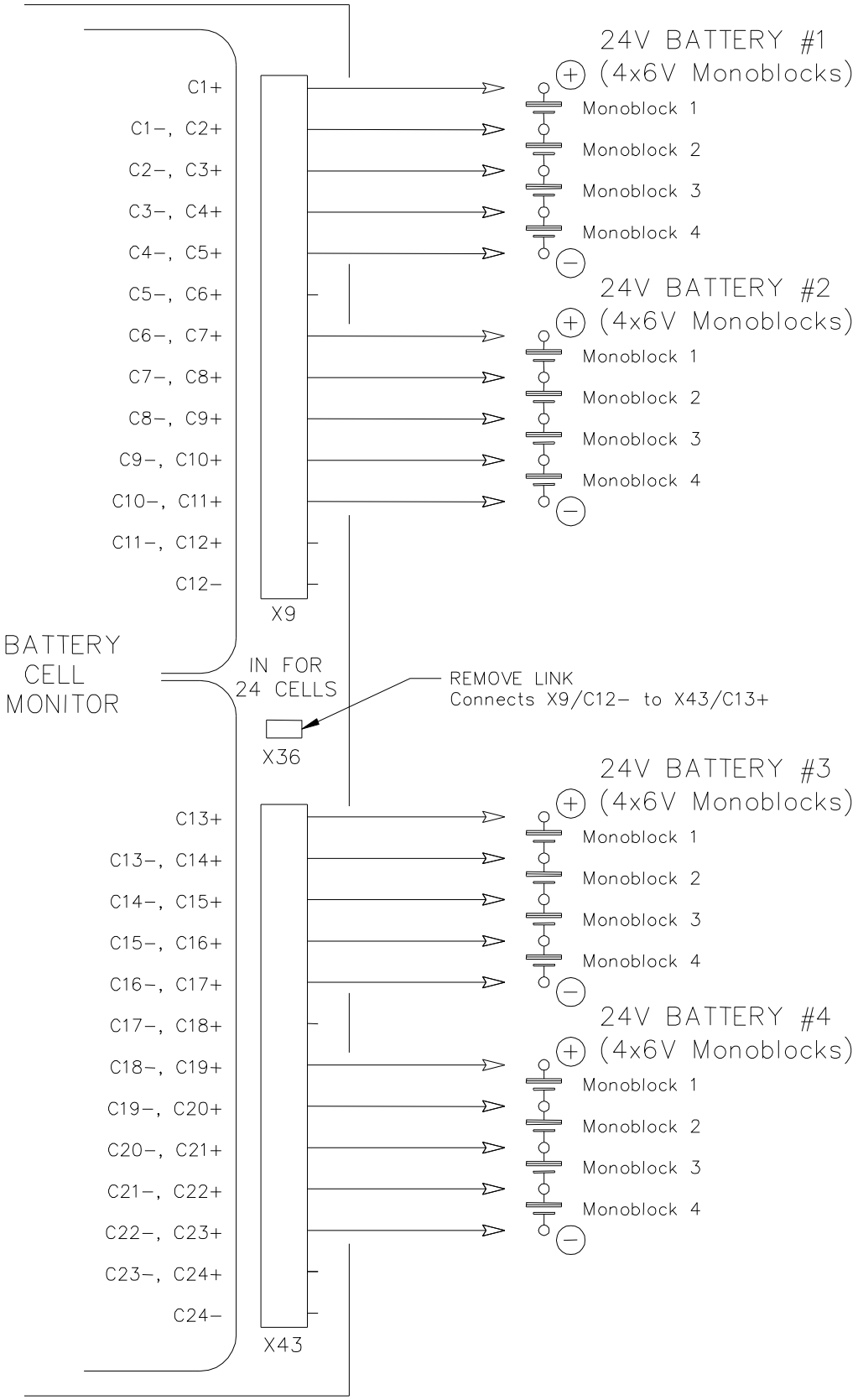
Figures 9.9 **BCM connections to up to four 48V (4 x 12V monoblock) battery banks.**



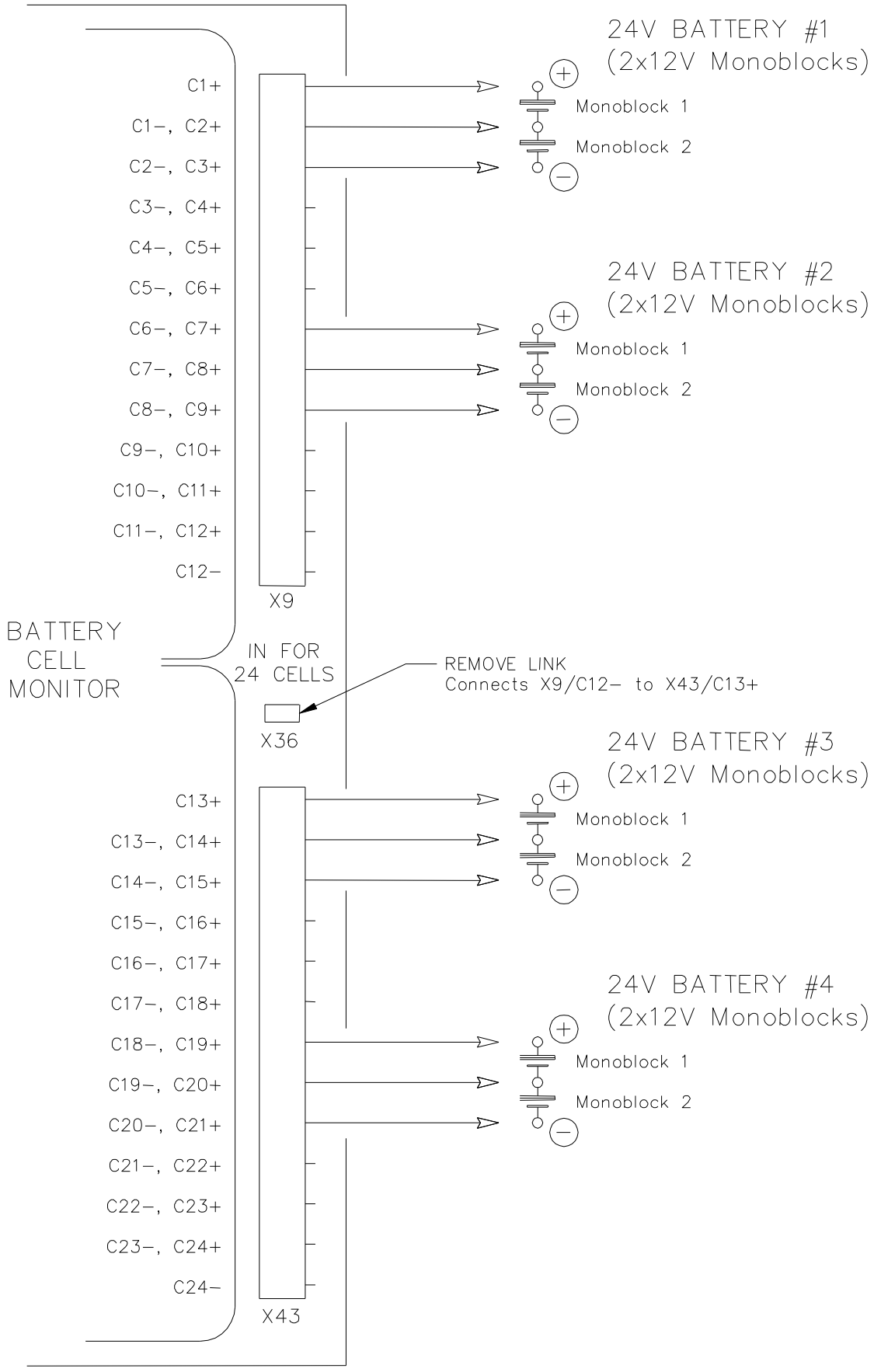
Figures 9.10 **BCM connections to two 24V (12 cell) battery banks.**



Figures 9.11 BCM connections to two 24V (6 monoblock) battery banks.



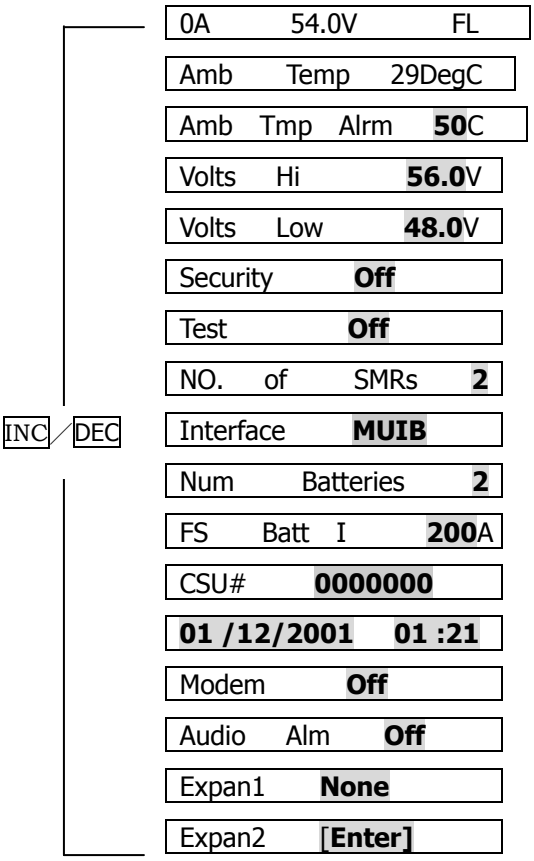
Figures 9.12 **BCM connections to four 24V (4 monoblock) battery banks.**



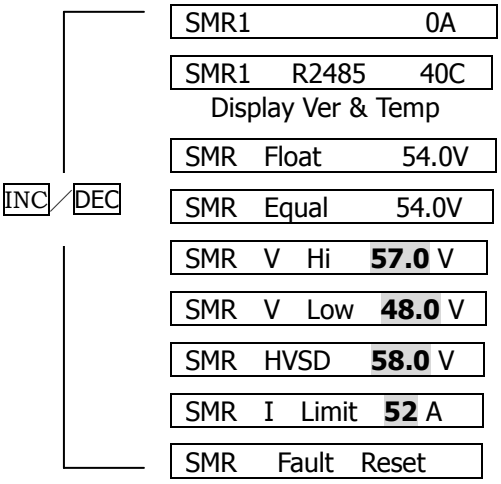
Figures 9.13 **BCM connections to four 24V (2 monoblock) battery banks.**

10. APPENDIX C – Flow of MCSU Menu Screen

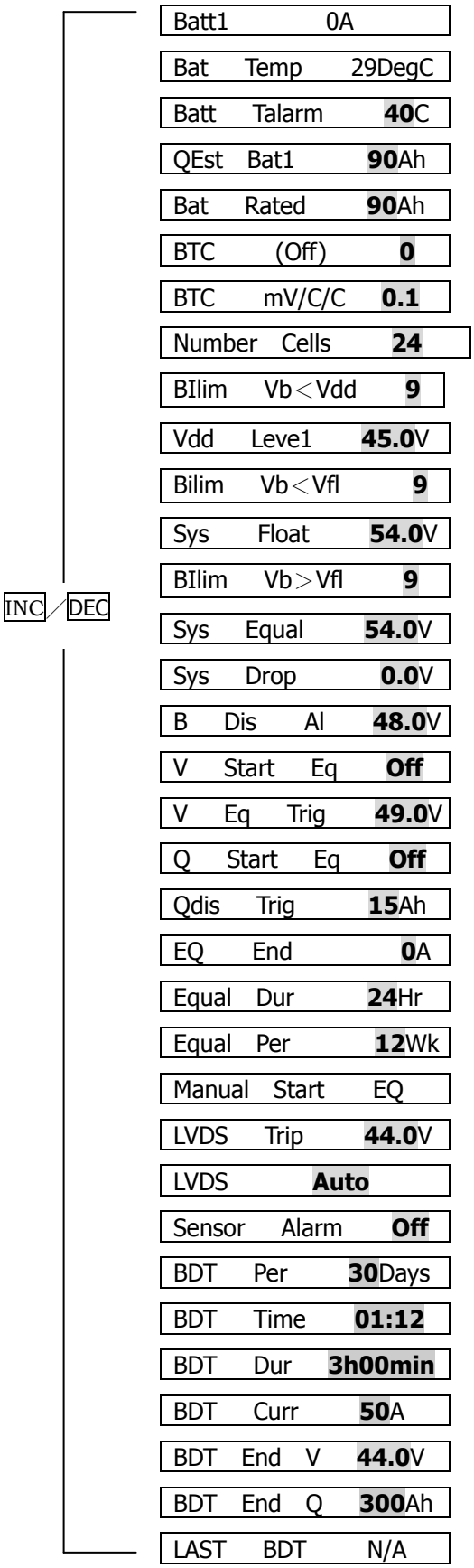
10.1. Home Menu



10.2. SMR Menu



10.3. Batt Menu



11. APPENDIX D – Remote Monitoring Software WinCSU2000

WinCSU is a monitoring and control program that extends the capabilities of AEC-CSU and AEC-MCSU to the Windows 95/98/NT4 platforms. Both controller types are referred to under the general term of CSU in this document, as the functionality is common to both.

WinCSU can be used to connect to any number of remote sites by modem. Each site is required to have its own phone number and CSU Access Code number. The CSU at each site can be configured to contact WinCSU by modem in the event of an emergency (alarm condition) or on a daily basis. WinCSU can also be directly connected to a single local CSU. Both emergency and daily reports are automatically saved if no WinCSU operator is present.

Information about the status of the system is divided into functional groups and presented in separate windows. Only windows containing information relevant to particular system configurations are shown on the screen. Access to operating parameters is available only as a pop-up window to avoid 'screen clutter' due to too much information.

Once WinCSU is installed and run, the on-line help file is made available and is highly recommended for use in conjunction with this manual.

11.1. Minimum System Requirements

The following equipment is required to establish a connection to a CSU:

- Computer running Windows 95/98/NT4 with at least 5MB of disk space available and 16MB of RAM
- A live Rack Power System using either a CSU or MCSU
- A means of connection - either a direct connect cable or a modem.

11.2. Operating Screen

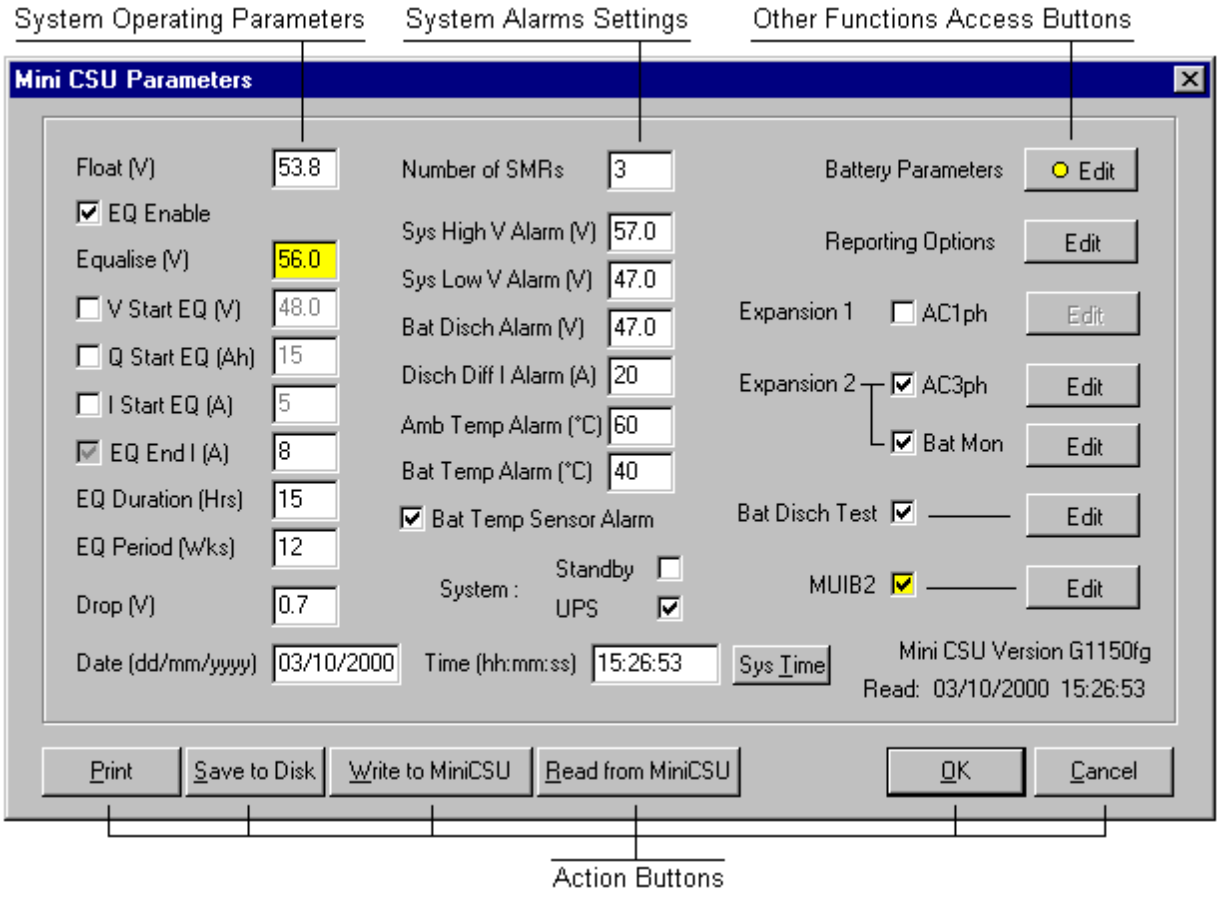


Figure 11.1 CSU Parameters Window

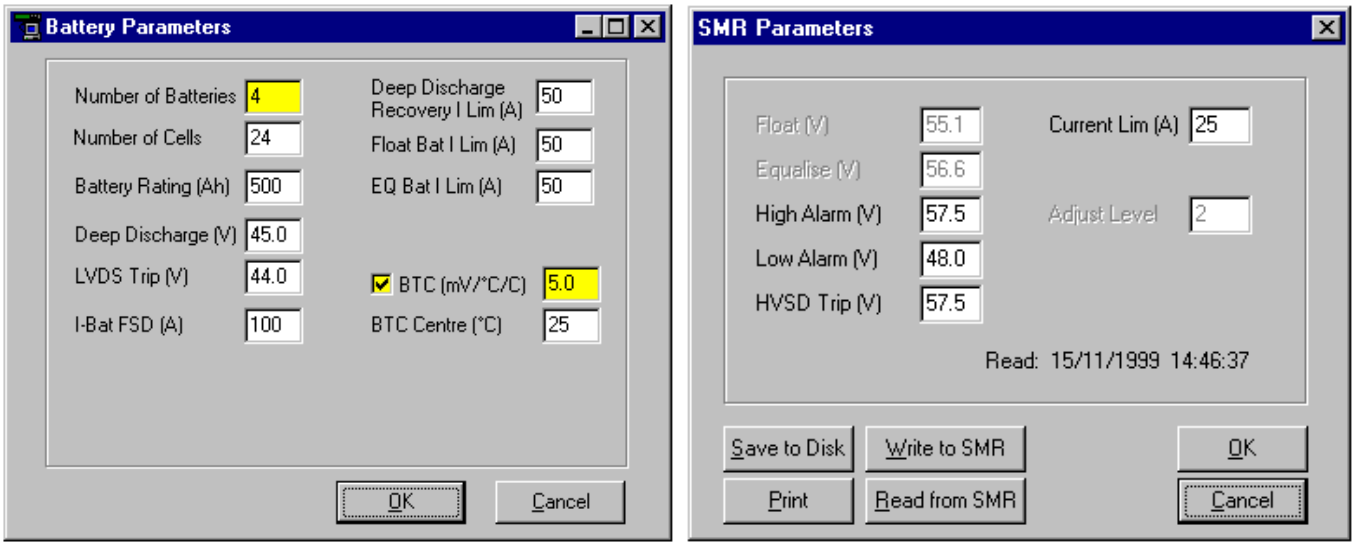


Figure 11.2 **Battery & SMR Parameters Window**

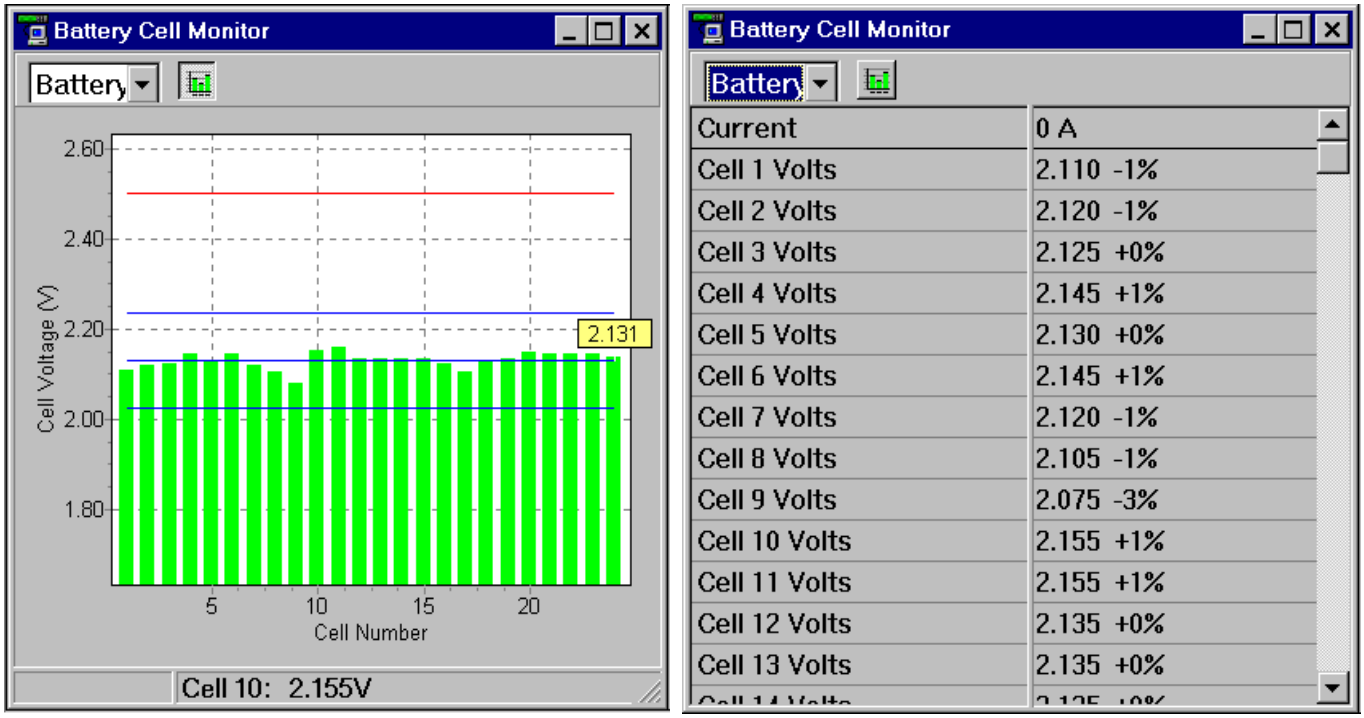


Figure 11.3 **Two alternate views of the Battery Cell Monitor window data**

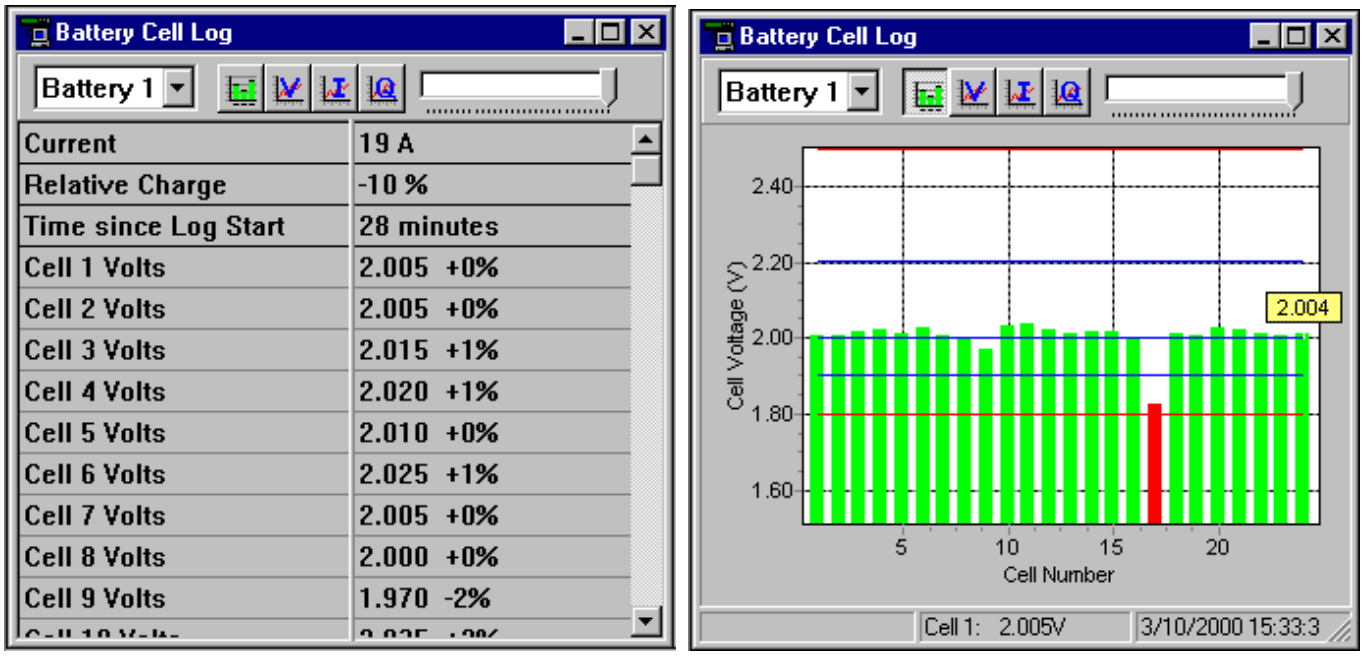


Figure 11.4 **Battery Cell Log data in a raw format and bar graph format Window**

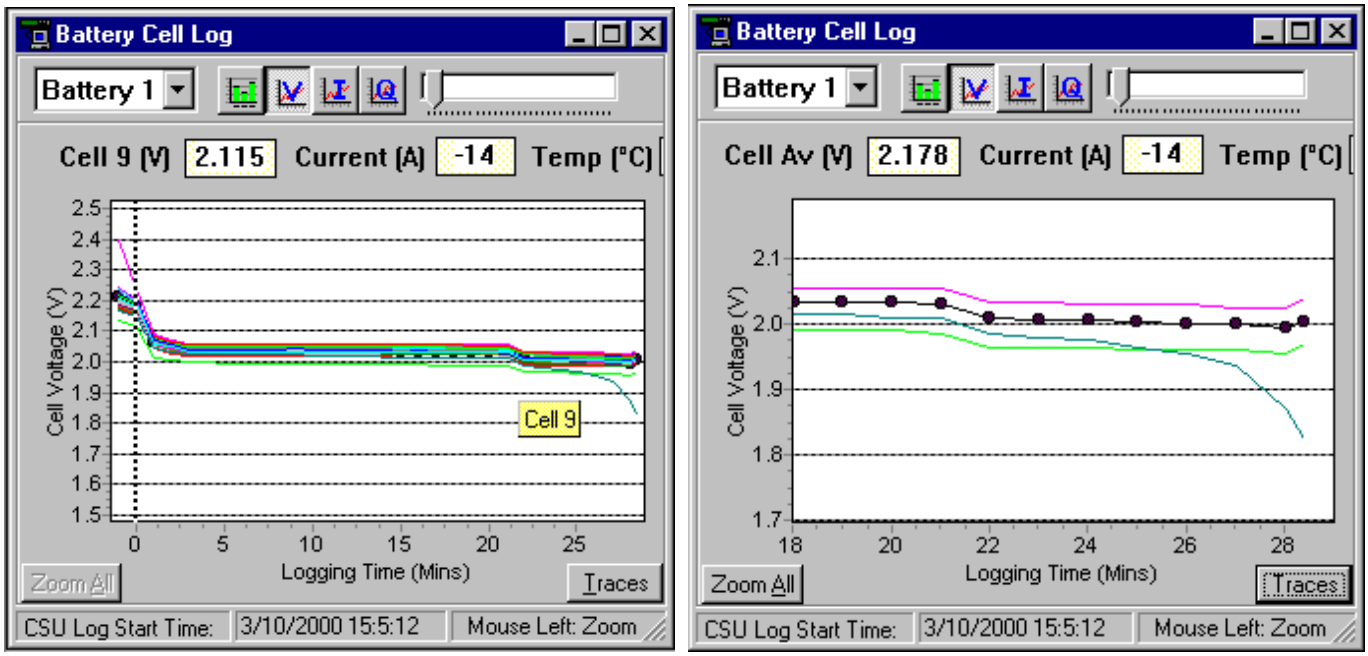


Figure 11.5 **Cell Voltage versus time for all cells over entire discharge time (left) and for selected cells over a 'Zoomed' section of time and voltage (right) Window.**

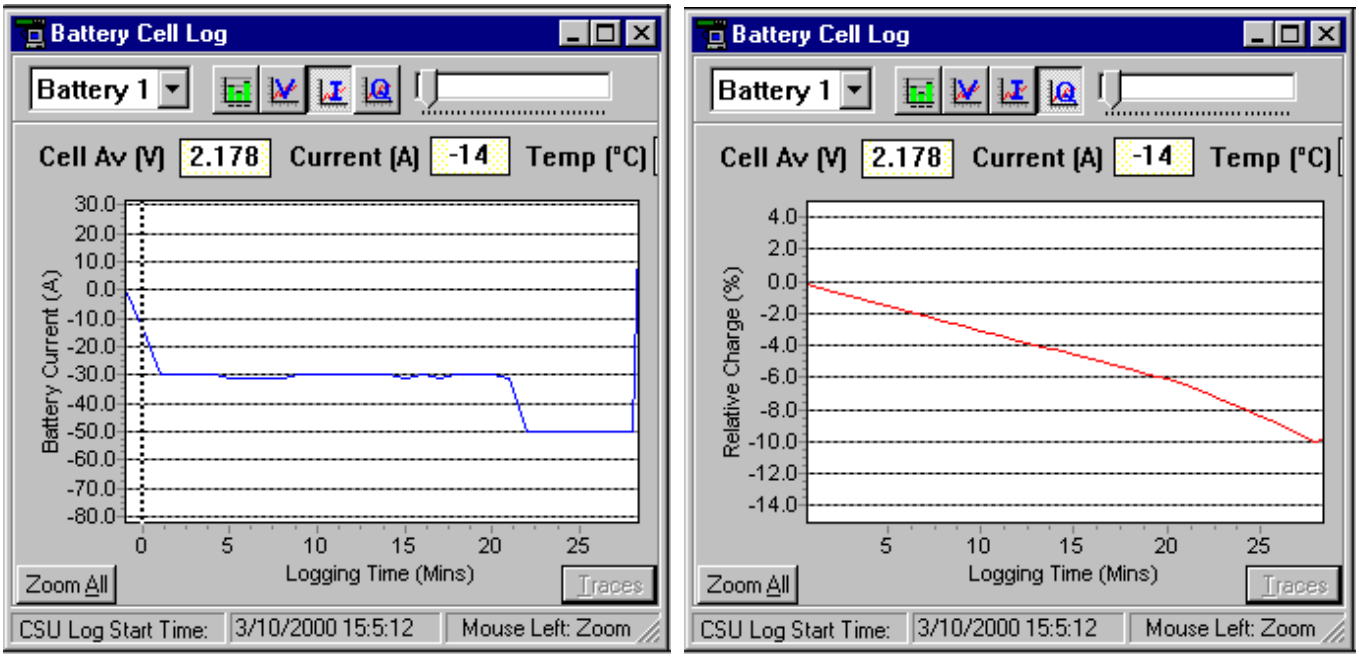


Figure 11.6 **Battery discharge current over time (left) and accumulated charge removal (right)**

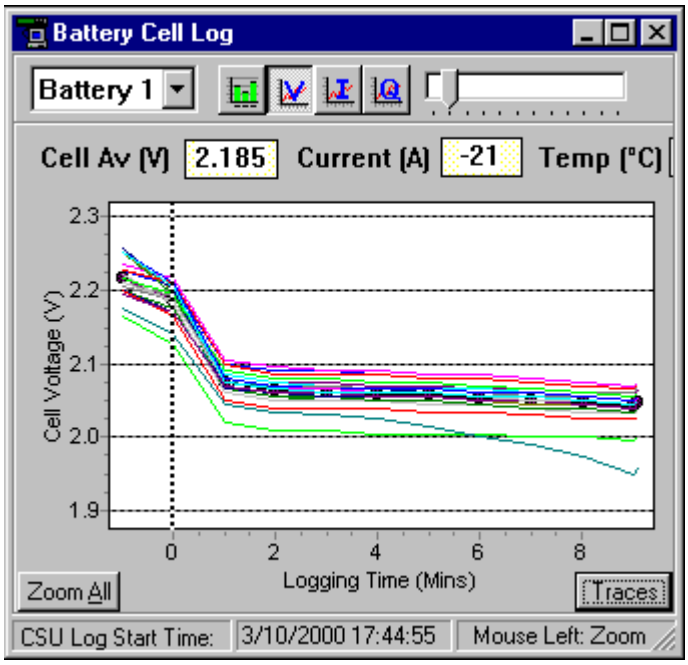
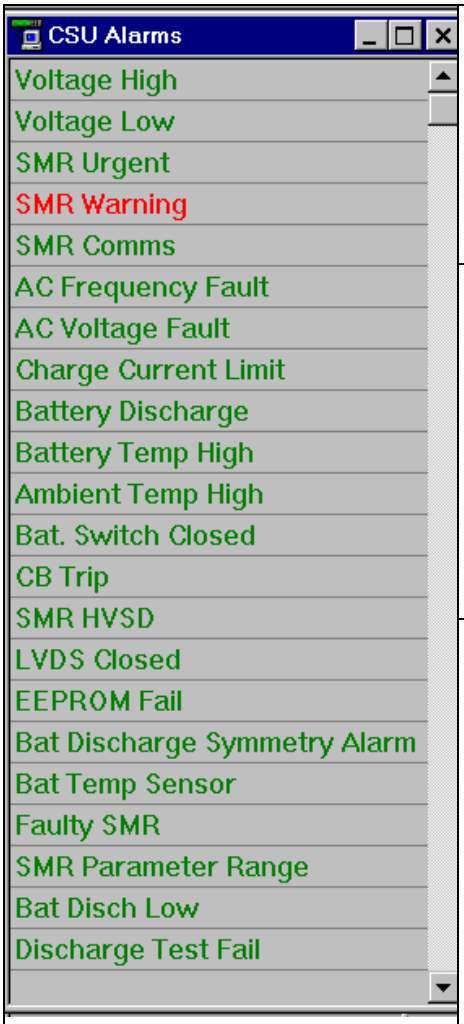


Figure 11.7 **Typical discharge log, showing up a problem with a cell Window**

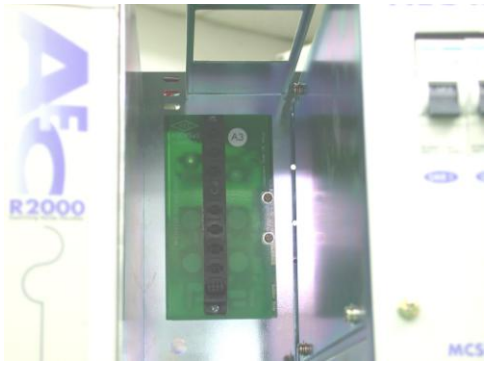
Figure 11.8 MCSU Alarms Table



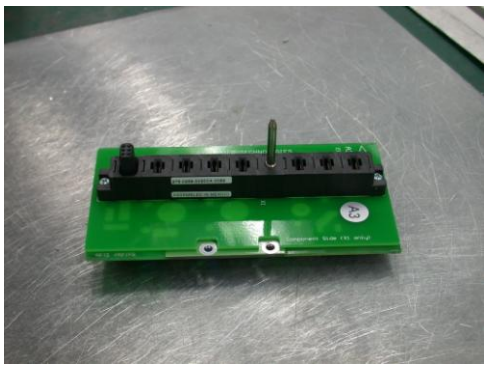
SMR Urgent	This alarm indicates one or more rectifiers is flagging a serious alarm such as HV shut down, or SMR Fail. The alarm is termed 'Urgent' because the system is no longer able to perform with its specified capacity. Such a condition requires immediate maintenance attention to prevent the possibility of a system failure.
SMR Warning	This alarm indicates a minor alarm on one or more rectifiers is present. The rectifiers being in current or power limit, or the system being under no load conditions can generate such an alarm. An SMR Warning Alarm only indicates that the rectifiers are operating at the extremes of their operation characteristic, which can easily occur when the power is first restored after a long discharge. As such, this alarm by itself is not meant to indicate a problem exists.
SMR Comms	A failure of the communications between the CSU and the rectifiers causes the SMR Comms alarm to be flagged. The usual cause is either a broken wire (bad connection) or that a rectifier is not responding because it has no power available for its internal microprocessor (check the SMR status window).
Bat. Switch Closed	On the MUIB, there is a connector that is designed to be linked through the auxiliary contacts of the battery circuit breakers. If the link is broken (circuit breaker opens), then this alarm is flagged by the text changing to Red with the words "Bat. Switch Open".
CB Trip	On the MUIB, there is a connector that is designed to be linked through the auxiliary contacts of the load circuit breakers where available. If the link is broken (circuit breaker opens), then this alarm is flagged by the text changing to Red.
LVDS Closed/Open	On the MUIB, there is a connector that is designed to be linked through the auxiliary contacts of the low voltage disconnection switch (LVDS). If the link is broken (LVDS opens), this alarm is flagged by the text changing to Red with the words "LVDS Open".
EEPROM Fail	This alarm is flagged if the CSU is unable to read/write/verify the data in its on board EEPROM. This function is checked whenever the CSU is required to update information stored in the EEPROM.
Faulty SMR	This alarm is flagged when the CSU finds an SMR that is outside the acceptable current sharing tolerance when passive current sharing is initiated. Note that this alarm is only valid for systems that use an analog current sharing scheme.
SMR Parameter Range	This alarm is flagged when the CSU tries to write a value of a parameter to a rectifier that is not within the specified range of the software limits in the rectifier. Check the system and rectifier limits in the system Installation and Operation Manual.

12. APPENDIX E – Back Panel PCB(BPA2)

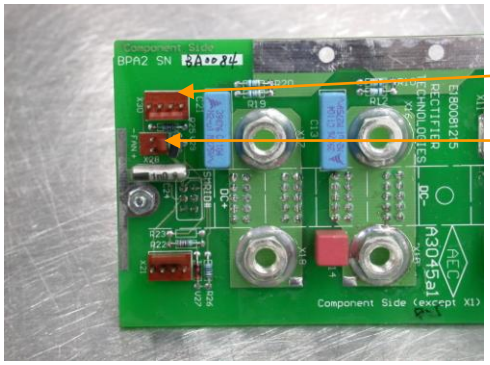
This is designed for integrating AC/DC connectors and communication link on one PCB board. It will be mounted on the back of magazine first for SMR end.



Where BPA2 is mounted in place.



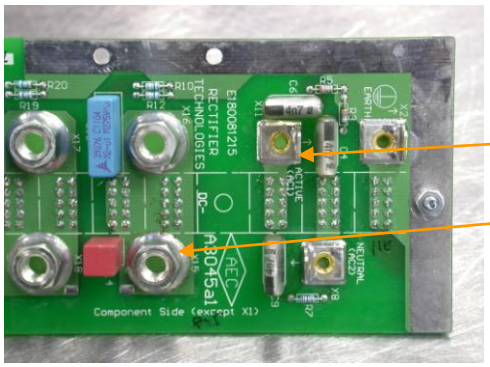
BPA2 outlook.



Communication terminal

Fan terminal

BPA2 Fan & communication terminals.

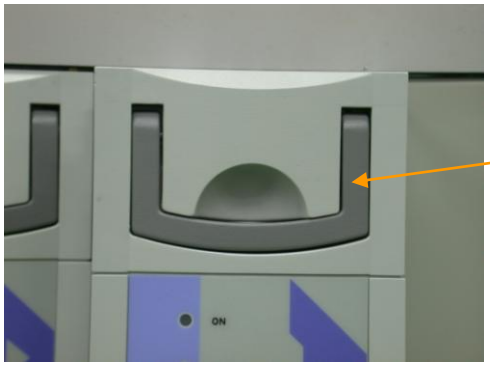


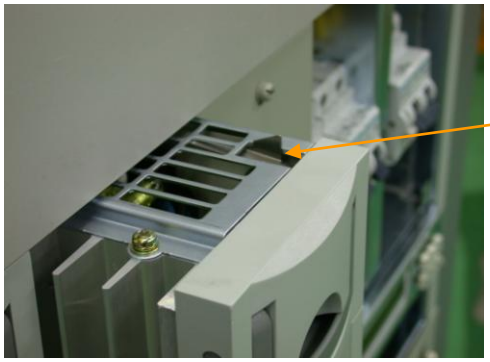
AC terminal

DC terminal

BPA2 AC & DC terminals.

13. APPENDIX F – Latch Lock Device

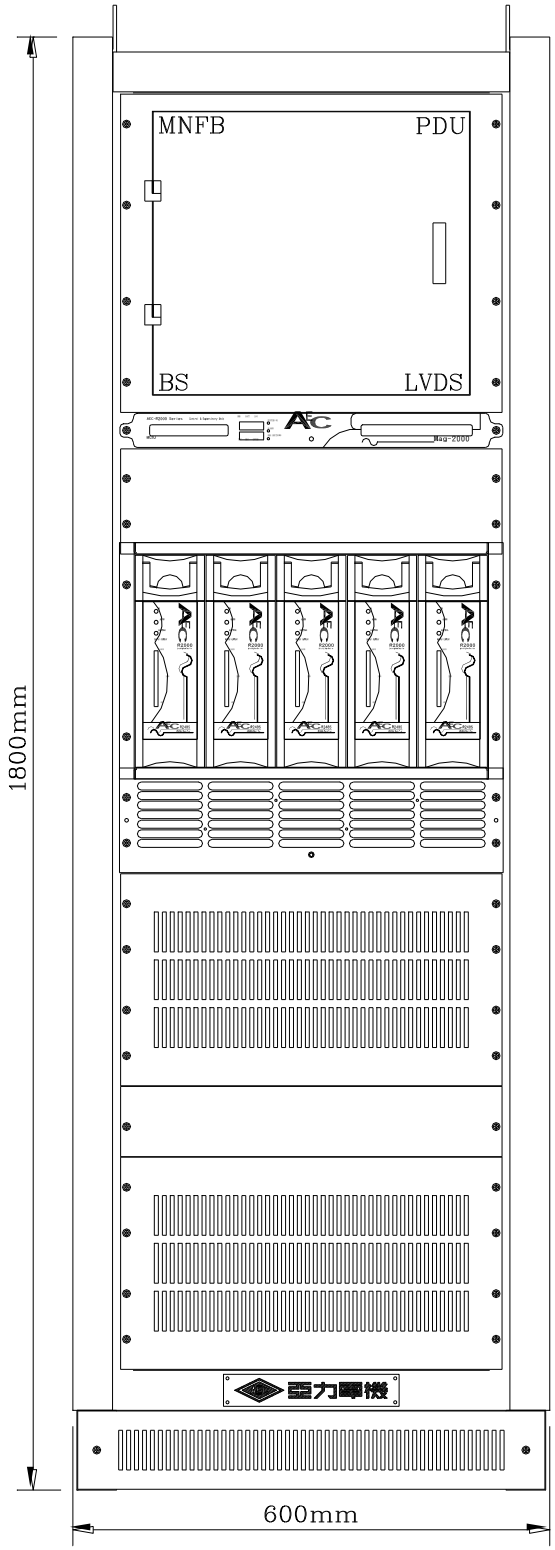




Pulling out the handle and then automatically unlock the latch.

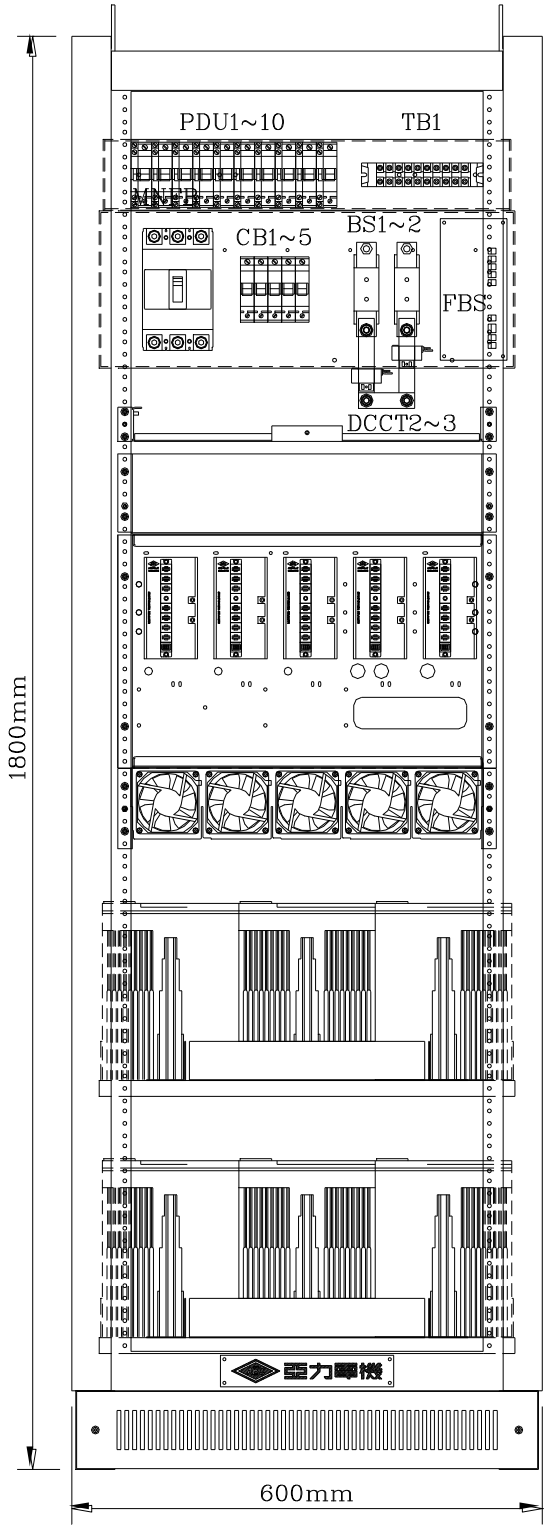
14. APPENDIX G – Example System Outline(RPS2250 250V/48Vdc)

14.1. Front View(External)



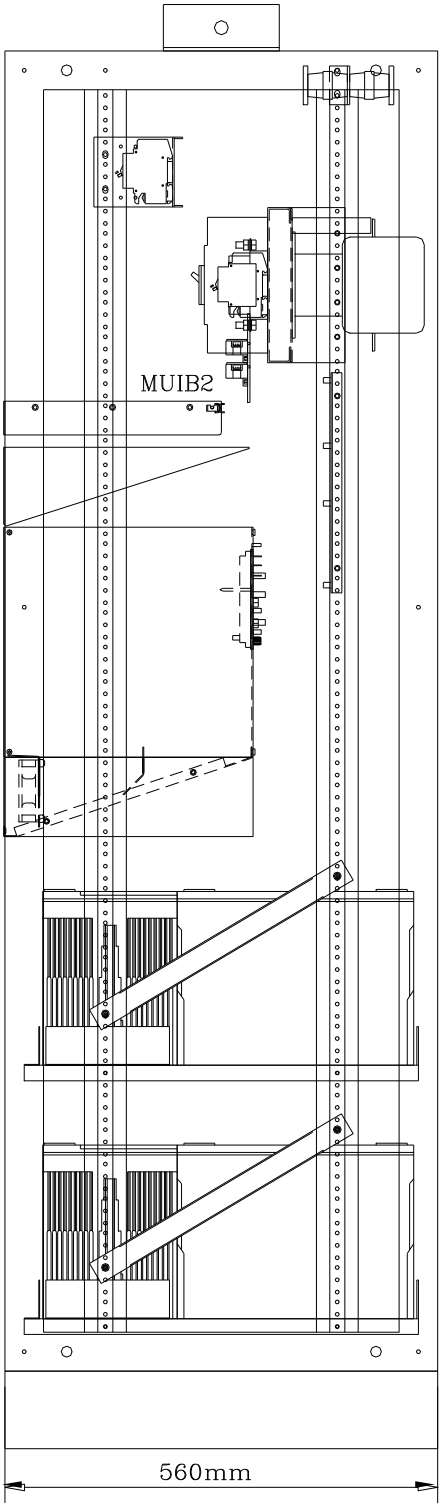
FRONT VIEW

14.2. Front View(Internal)



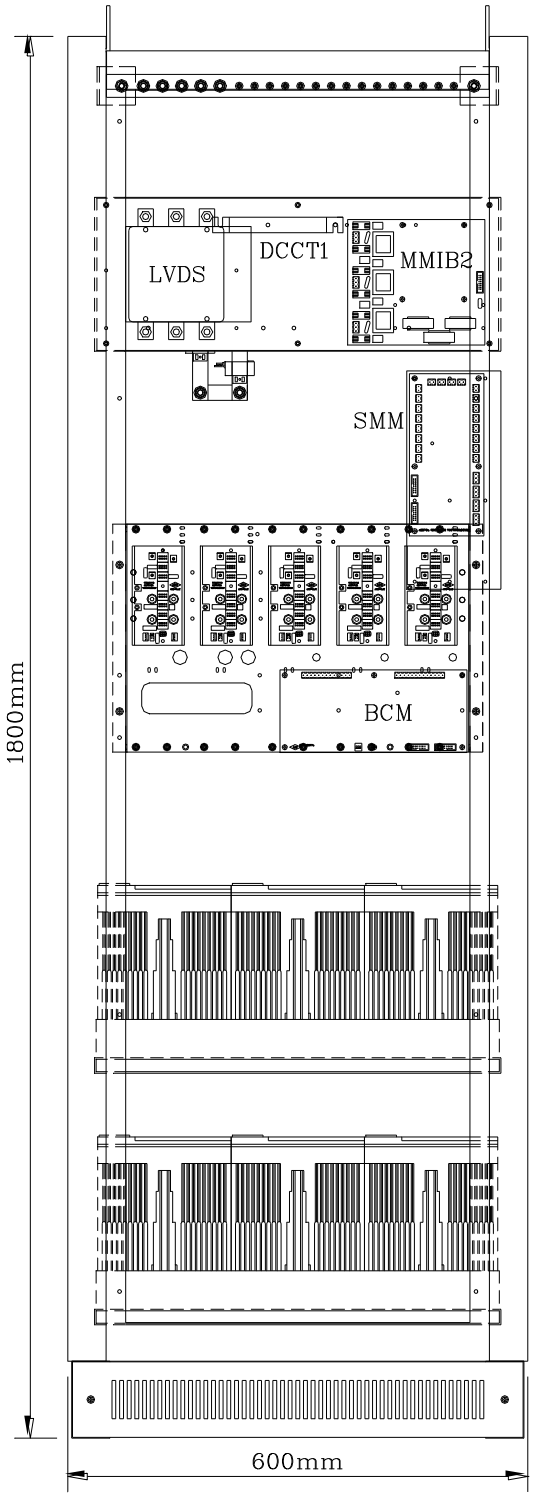
FRONT VIEW

14.3. Side View



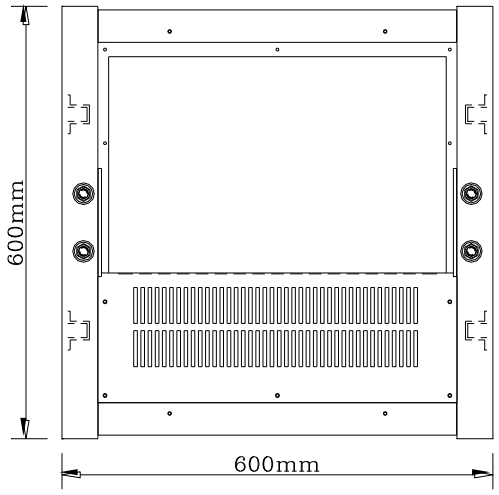
SIDE VIEW

14.4. Rear View

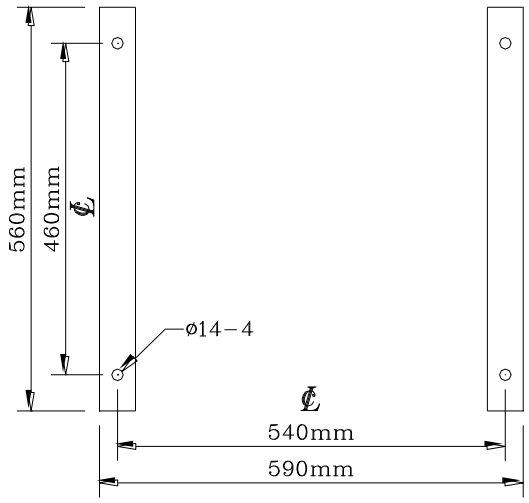


REAR VIEW

14.5. Top View



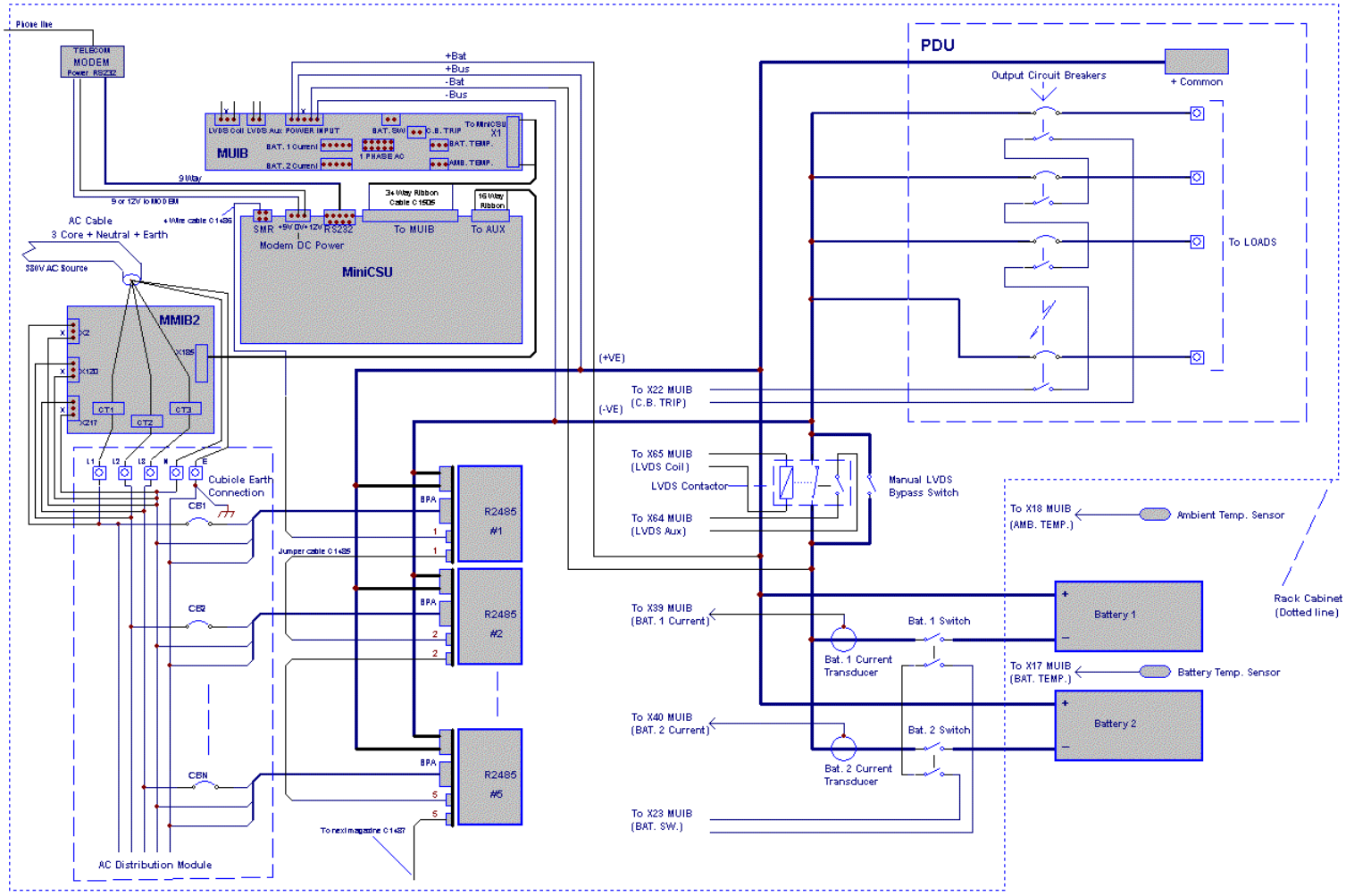
TOP VIEW



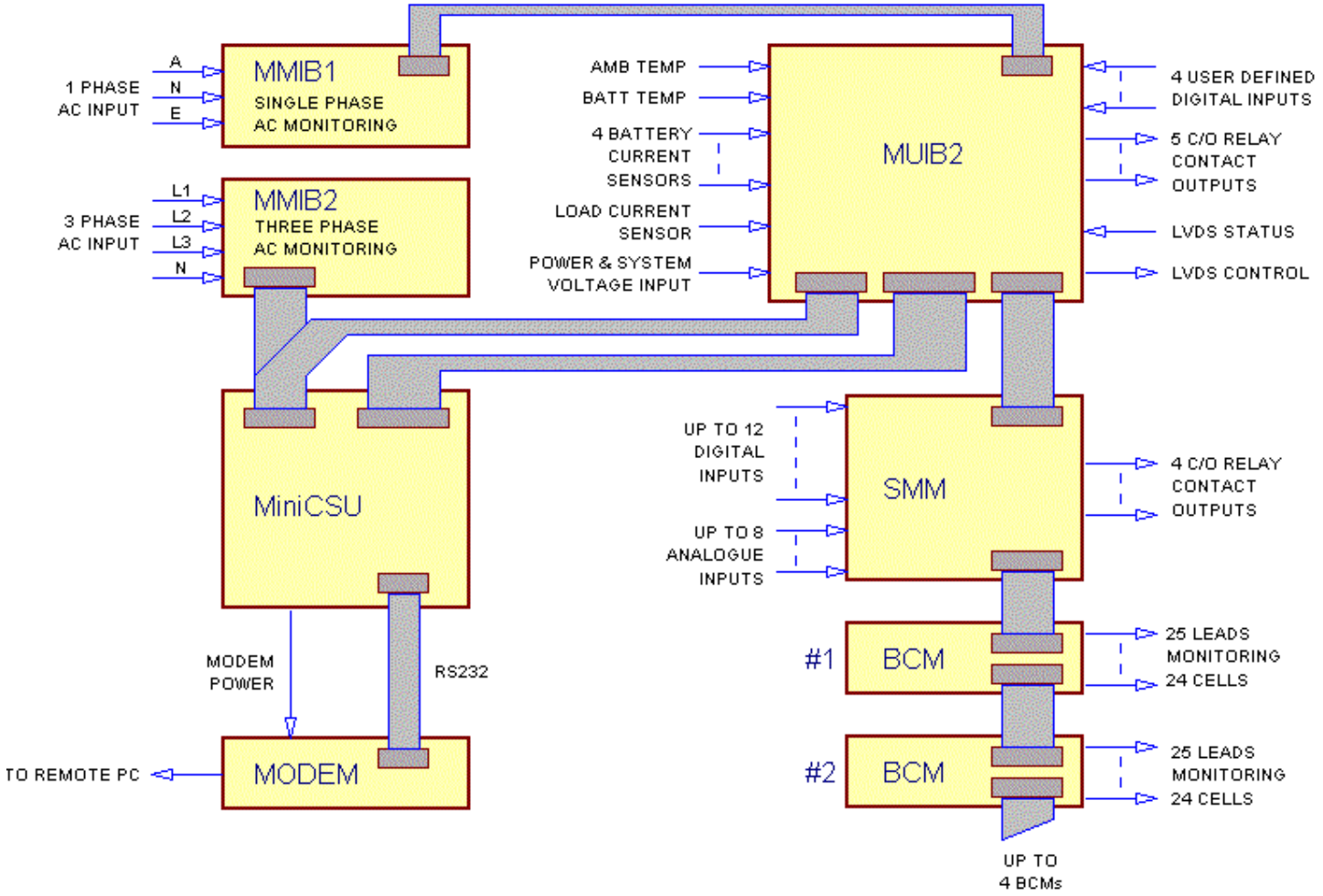
BASE STRUCTURE VIEW

15. APPENDIX H – Diagram

15.1. Typical Rack Wiring Diagram



15.2. System Interface Board Diagram



15.3. BCM Connector Diagram